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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

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Star and Satellites

ONLY once in every six years or so does Christmas Day fall on a Friday (Leap Years confuse the issue, as well as bachelors, and one of these chronological phenomena starts next Friday). So, as 1959 offers a happy conjunction of the great festival with *Flight's* publication date, we can with timely voice say "Merry Christmas," in whatever language is appropriate, to readers from Bristol to Buenos Aires, from Amsterdam to Adelaide, from Moscow to Mukden.

It may be that, lapped in the material benisons with which the simple spirit of Christmas has become laden through the Christian centuries, even the hardest-headed executive of Boeing or Rolls-Royce or Fiat or SNECMA slumbers awhile in unrepentant uncommercial dreams. Perhaps even the keen brains of Mm. Antonov and Tupolev exercise themselves only upon the dihedral of paper darts for children's parties, whilst Mr. Douglas counts-down nothing more explosive than a Christmas cracker.

Which is all as it should be; for at Christmastide the international and scientific tensions which twinge this ageing world's subconsciousness are for a brief time relaxed; and if the Star of Bethlehem now shares its sky with man-sown satellites from the U.S.A. and U.S.S.R., the achievement may seasonably be regarded as matter for human self-congratulation rather than for international rivalry and national self-criticism.

The half-century since man first achieved heavier-than-air flight has seen the physical dimensions of his life change beyond recognition, not only with the majestic exploration of space but with commercial comings and goings at speeds and heights once considered impossible but now commonplace. Almost every aeronautical development for military purposes leads eventually to some advancement for the civil good: jet-powered transport has narrowed the oceans and negatived the terrors of the desert; lower and slower-flying aircraft have nurtured the earth to make it bring forth abundantly, have plucked men to safety from ocean storms and the muddy horrors of flood; rocket-launched satellites have photographed the unknown side of the moon and broadcast a human message of peace from outer space.

The moral of all this does not need over-emphasizing. And because at this season all men of goodwill are sensible to such benevolent thinking, we can with confidence extend to them . . .

Greetings Today & Good Wishes

for the Adventure of Tomorrow

FROM ALL QUARTERS

Hawker Siddeley Bid for D.H.

COMING as a surprise to the City, it was announced on December 16 that the Hawker Siddeley Group and the de Havilland Enterprise plan to merge. Such a move would represent a major advance towards the semi-monopolistic industry which the Minister of Aviation would like to see.

During recent weeks de Havilland have been linked in the Press with English Electric Aviation, and as these words are written it is still conceivable that the latter company could remain in the picture. Nevertheless, the Boards of both Hawker Siddeley and de Havilland Holdings have expressed full agreement with the proposed merger and it only remains for the shareholders to express their opinion. As might be expected, it is Hawker Siddeley who have made the offer; and this takes the form of one Hawker Siddeley ordinary share for one unit of D.H. stock (at the time of writing this means 29s 10½d for 22s 6d), and three Hawker Siddeley 5½ per cent preference shares plus 20s in cash for every four units of D.H. 5½ per cent preference stock (equal to approximately 19s for 15s 9d). The total number of de Havilland ordinary shares is 8,770,918 and there are 1,200,000 preference shares, so that the total Hawker Siddeley offer amounts to rather more than £14.2m.

At this early stage the full implications of the proposed merger cannot be assessed accurately. It will be remembered that when Westland Aircraft acquired control of the aeronautical portion of Saunders-Roe Ltd., the non-aircraft side of this company remained with the de Havilland Enterprise, and is presumably included in the deal with Hawker Siddeley. Further complications are introduced by the existence of the Aircraft Manufacturing Company, an *ad hoc* consortium to produce the Airco D.H.121, in which D.H. Aircraft are the senior partner in a triumvirate with Fairey Aviation and Hunting Aircraft. Hawker Siddeley have also been singularly active in recent months, acquiring Folland Aircraft in September and making a £4m bid for Blackburn Aircraft earlier this month. It is also pertinent to refer to Bristol Siddeley Engines, half of whose share capital is owned by the Hawker Siddeley Group. Current net Stock Exchange value of the Group's assets is approximately £67m; the corresponding figure for the Enterprise is around £17m.

U.S.A.F. Claim 1,521 m.p.h., 103,396ft

WORLD records for speed and altitude are claimed by two U.S.A.F. officers as a result of recent Century-series missions. That for speed was achieved by Maj. Joseph W. Rogers, flying a Convair F-106A Delta Dart (P. & W. J75) from Edwards; his runs were timed at some 1,535 and 1,505 m.p.h., and the mean figure submitted is 1,520.9. That for altitude was achieved by Capt. Joe B. Jordan, flying a Lockheed F-104C Starfighter (G.E. J79), also from Edwards. Some information on his flight to almost 20 miles up is available.

Capt. Jordan said that he climbed at 45 deg to 40,000ft and then "pulling the stick back, went virtually straight up." In fact, he must have accelerated to some 1,500 m.p.h. on the level before pulling up into a ballistic trajectory, trading speed for height. Under such conditions wing lift and engine thrust are of secondary importance and it is only remarkable that the J79 continued to work in the thin air. At top altitude neither the cockpit altimeter nor ground radar could be relied upon and it was only the presence of theodolite cameras on the Mojave Desert which allowed the precise figure submitted for F.A.I. ratification to be calculated at 103,395.5ft.

HAWKER SIDDELEY DEVELOPMENTS interested the Air Minister, Mr. George Ward, when he visited the Richmond Road, Kingston-upon-Thames, works recently. The Minister is at left; with him, l. to r., are Mr. E. T. Rowe, Sir Sydney Camm and Mr. J. T. Lidbury

Rolls-Royce Design Posts

FOUR new appointments have been announced by Rolls-Royce Ltd. in the design organization of the company's aero-engine division. Mr. F. W. Morley becomes chief design engineer; Mr. A. H. Fletcher design manager; Mr. D. McLean chief designer, by-pass engines; and Mr. D. O. Davis chief designer, jet engines.

Mr. Morley has been chief designer, military engines, since 1954 and in charge of the design of all Avon series military and civil engines. Latterly he has been responsible for the design of the RB.141 (referred to on this page last week) and RB.163 engines.

Kuwait's Repeat Order

WESTLAND have received a follow-up order for three Whirlwinds from Sheikh Abdulla Mubarak al Sabah, Deputy Ruler of Kuwait and that country's President of Civil Aviation. The aircraft will join a Whirlwind delivered on an initial order late last October. The first of the new batch started on its 3,800-mile journey on December 15 and the remaining two will follow in the middle of January 1960.

Powered by Pratt & Whitney R-1340s, the Kuwait Whirlwinds are equipped for a variety of rôles. Seats are provided for seven or eight persons, and extra equipment includes flotation, long-range tanks, external-freight sling, a winch hoist capable of lifting 400 lb or two persons, and a Sproule scoop net for marine rescue.

HYDRODYNAMIC JET: The transom of the Dowty Group's new water-jet boat, described opposite. Seen here are the jet nozzle and the deflecting vanes which give directional control; neutral and reverse thrust are also obtainable. Power is provided by a modified Ford Zephyr engine driving a two-stage axial pumping unit

FILM STAR: Bristol Siddeley's test-bed Avro Ashton, WB493, has been flying for a new British film based on David Beaty's novel "Cone of Silence." This aircraft was chosen by the producers because its unusual configuration should prevent its being mistaken for any aircraft in service. The port side has been painted in red and white livery

NASAL ACCENT: The recent fitting of the brown plastic radar nose cone on this Blackburn NA.39 indicates that its Ferranti search and attack radar is now being tested

Jet Boat

LAST week the Dowty Group publicly demonstrated the Dowty Turbocraft pleasure boat now being produced by Dowty Marine Ltd. Propulsion is by a modified Ford Zephyr engine, giving some 70 h.p., directly driving a two-stage axial pumping unit which projects a high-speed jet of water rearwards just above water level. The intake is flush with the bottom of the boat immediately ahead of the turbine and vanes controlled by the tiller deflect the jet laterally for directional control. A gate can be lowered into the jet to provide neutral or reverse thrust. In the 14ft 6in, four-seat, glass plastics speed-boat hull to be mass-produced by Dowty Marine, the propulsion system gives a speed of 35 m.p.h., very high acceleration and the ability to apply full helm and turn in the boat's own length at top speed.

Advantages claimed for the Turbocraft principle, which was originally developed by the C.W.F. Hamilton Co. Ltd., Christchurch, New Zealand, are safety to persons in the water (because of the absence of any rotating or protruding parts beneath the hull), ability to operate at full speed in as little as 6in of water, extreme manœuvrability, and the ability to produce full power at rest (and hence remarkable acceleration). The three-stage turbine has been applied in New Zealand to drive a 15-seat passenger boat at 30 m.p.h. on shallow rivers. The system has obvious attractions in relation to boats operating in conjunction with aircraft, e.g., for rescue work, and also in a variety of military applications.

"Jane's" is Fifty

FIFTY years of *Jane's all the World's Aircraft* were celebrated at a reception at Londonderry House on December 15. Coincident with the publishing of the 1959-60 Golden Jubilee edition (Sampson Low, Marston, £5 5s) it has been announced that this will be the last volume produced under the editorship of Leonard Bridgman. Third editor of *Jane's*, Mr. Bridgman joined C. G. Grey in 1919 and took over in 1940. He will be succeeded by John W. R. Taylor—frequent contributor to *Flight*—who has been his assistant since 1955.

Included in the 1959-60 volume are 32 pages reprinted from *All the World's Airships* of 1909 (the first volume published). Other points of note are the expected substantial increase in the section dealing with guided missiles and space vehicles, the first guarded references to Soviet missile types, and further details of four Russian military aircraft known to NATO as Boot, Bounder, Brawny and Fitter. The separate sections on piston and gas-turbine engines have been merged, and a decision which will be widely welcomed is that of including a horde of American "home-builts" and light aircraft.

AS LARGE AS LIFE: Layout draughtsmen in Short Bros. & Harland's lofting department at Belfast at work on the full-scale plans of the SC.5 Britannic, using a table measuring 120ft by 20ft. From the master drawings, duplicates are made lithographically on metal for the production of templates. Bristol are designing and lofting the wing and Saunders-Roe the rear fuselage and tailplane

IN BRIEF

An inconclusive combat was fought over the frontier between Syria and Jordan on December 14, between four Jordanian Hunters and four U.A.R. Mig (presumably -17) fighters.

Ghana has ordered HT-2s from the Hindustan Aircraft Factory at Bangalore and an initial batch has been despatched to the Ghana Air Force.

In recognition of his services to sporting aviation and the Royal Aero Club, Col. R. L. ("Mossy") Preston was guest of honour at a dinner at the Royal Aero Club on Wednesday of last week, with Lord Brabazon in the chair.

The speed record of 1,216.48 m.p.h. set up by Brig-Gen. Joseph H. Moore in a Republic F-105 Thunderchief on December 11 over a 100 km course at Edwards A.F.B. has been approved by the National Aeronautic Association and is being submitted to the F.A.I. for ratification. General Moore said at a Press conference afterwards that the F-105, which he flew at 36,000ft, was doing more than 1,400 m.p.h. before he entered the set course.

The former R.N. air station at Ford, Sussex, is definitely to become a "prison without bars." The Ministry of Housing and Local Government announced last week that the much-discussed proposal has been approved.

Miles Electronics Ltd. recently delivered to the Royal Navy a Sea Vixen flight simulator, in which Ultra Electric Ltd. co-operated in the radar simulation systems. A member of the Miles Group of companies, Miles Electronics have also been awarded a contract for an NA.39 simulator.

Group Developments Ltd., parent company of Cellon Ltd., have signed a paint "know-how" agreement with Glidden International, subsidiary of one of the leading American manufacturers, the Glidden Co. of Cleveland. This gives Group Developments and its subsidiaries access to up-to-date information on U.S. technical developments, manufacturing methods and marketing techniques.

At a recent dinner at R.A.F. North Coates, Lincs, the officers' mess was presented with a piece of silver to commemorate an important stage in the station's equipment as a base for Bloodhound missile squadrons. Bearing a representation of the A.E.I. Sting-Ray target-tracking and illuminating radar, it was presented on behalf of the A.E.I. Military Radar Group by Mr. V. M. Roberts, divisional commercial manager, and received by W/C. H. L. Derwent, the station commander.

LEAVING CHRISTCHURCH to live in Australia: Maj. Hereward de Havilland (left), whose retirement from the family business was referred to on this page on December 4

APPOINTED chief design engineer of the Rolls-Royce Aero-engine Division, Mr. F. W. Morley (centre left) has been with the company since 1937. His recent work as chief designer, military engines, is referred to opposite

NEW DIRECTORS of Flight Refuelling Ltd. are Mr. A. W. Goodliffe (centre right), who has been appointed chief engineer after seven years as chief designer, and Mr. J. E. Burnett (extreme right), who recently joined the company from Helliwells Ltd. and has been appointed works manager

Largest ballistic vehicle yet to reach the hardware stage, NASA's Saturn booster will employ eight Rocketdyne H-1 engines giving an aggregate thrust of some 1.5m lb. This photograph shows the framework of the booster being erected; a central 105in tank will eventually be surrounded by eight 70in tanks

Missiles and Spaceflight

UNITED NATIONS SPACE AGREEMENT

A major step forward in international space-research co-operation was the joint draft resolution, at United Nations on December 11, calling for a conference on the peaceful uses of outer space to be held in 1960 or 1961, and for the establishment of an international outer-space committee. A temporary 18-member committee was set up by the UN General Assembly last year, but contained no representative from the Soviet Union.

A proposed new committee on the peaceful uses of outer space would consist of representatives from Albania, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Czechoslovakia, France, Hungary, India, Iran, Italy, Japan, Lebanon, Mexico, Poland, Rumania, Sweden, U.S.S.R., United Arab Republic, the United Kingdom and the U.S.A. The resolution requested the committee to "review as appropriate the area of international co-operation and study practical and feasible means for giving effect to programmes in the peaceful uses of outer space which could appropriately be undertaken under United Nations auspices." This would include (1) assistance for the continuation on a permanent basis of research carried out within the IGY framework, (2) organization of the mutual exchange and dissemination of research information and (3) encouragement of national research programmes. The committee would also study legal problems arising from outer-space exploration.

The second part of the resolution noted with satisfaction "the successes of great significance to mankind that have been obtained in the exploration of outer space in the form of the recent launchings of artificial Earth satellites and space rockets." Following on from this, the resolution recommended that the General Assembly should convene in 1960 or 1961 an international scientific conference for the exchange of experience in the peaceful uses of outer space.

The sponsors of the draft resolution were Brazil, Czechoslovakia, France, India, Japan, Poland, Rumania, Sweden, United Arab Republic, U.S.S.R., United Kingdom and the U.S.A. The agreement was unofficially attributed by UN observers to the efforts of Henry Cabot Lodge (U.S.A.) and Vasily Kuznetsov and Arkady Sobolev (U.S.S.R.), backed by negotiations in which the Australian and Canadian delegations played a leading rôle.

At a meeting of the UN Main Political Committee at which the draft resolution was endorsed, Mr. Cabot Lodge said that outer space could not be "anyone's private preserve." Without international co-operation, he said, activities in outer space would begin to conflict and frustrate each other—the radio spectrum, for example, could become overcrowded. Mr. Kuznetsov, the Soviet Deputy Foreign Minister, opposed a proposed Belgian amendment that the forthcoming conference should be restricted to members of the UN and its specialized agencies. With China obviously in mind, he said "one cannot fail to take account of the fact that those countries which are members neither of the United Nations nor the specialized agencies, find themselves outside these bodies for reasons altogether outside their control; and it would be unjust to deprive them of the possibility of taking part in this new venture of the joint study of outer space."

VEGA CANCELLATION

In order to reduce the number of rocket vehicles used in the U.S. space programme, development of the Vega rocket has been stopped. This was announced by the National Aeronautics and Space Administration on December 11, when it was stated that other rocket vehicles would be used to accomplish the satellite and space-probe projects for which Vega had been planned. The Vega development programme was estimated to cost $65m, according to NASA, of which all but $17m would be recovered as a result of the cancellation decision.

Designed to be capable of carrying a 760 lb space-probe payload; carrying 1,000 lb to the vicinity of the Moon; landing "several hundred pounds" on the Moon; or placing 5,000 lb in orbit around the Earth, the Vega project would have involved both two-stage and three-stage systems. In each case an Atlas would have been the first stage. The substitute vehicle for Vega missions will now be the Atlas-Agena, in which the Lockheed Agena second-stage, incorporating the Bell Hustler engine (as used in the Discoverer programme), will be linked with the first-stage Atlas. Development of the third-stage engine of the cancelled Vega project will be continued for use "in large spacecraft of the future." This engine is a product of NASA's Jet Propulsion Laboratory.

A NASA spokesman said that Vega had been viewed strictly as an interim rocket for use only until the three-stage Centaur went into production. Because of delays it now appeared that both Vega and Centaur would have come into operation about the same time—in approximately a year's time—and this was the reason for the Vega cancellation.

TITAN SLIPS

Exceedingly careful planning by the Denver Division of the Martin Company produced an auspicious start to the flight-test programme of the SM-68 Titan ICBM. However, since the excellent flight of A-6 on May 4, nothing seems to have gone right for the company team at Cape Canaveral.

First of the spectacular failures occurred on August 14, when premature release of the hold-down clamps let the missile go before the umbilical connections had been ejected, and the resultant malfunction signal cut off first-stage propulsion, allowing the missile to fall back to the pad and explode. There have been two structural failures owing to excessive pressure differential occuring across Titan tankage sections. In one case an improperly vented Titan burst while being airlifted to Cape Canaveral in a Douglas C-133. In the second instance a Titan liquid-oxygen tank collapsed inwards as a result of fuel being supplied through too short a feed-line, which did not allow the fuel time to warm up to match the temperature of the air in the tank.

A Titan C reached the pad at Cape Canaveral at the beginning of this month. The launching was postponed after an automatic sequence system signalled engine cut-off owing to failure of a valve to close (this signal was later found to be spurious). The missile was finally counted down on December 12 but blew up on the pad for reason which had not been disclosed at the time of going to Press. This was the first Titan to wear the more pointed ablative nosecone which Avco have been developing under their new $73.36m contract. As the photograph shows, the new cone has an included angle of some 45 deg and a tip radius comparable with that of the G.E. Mk 3 cone now worn by Atlas. Avco have said that the new cone will "tolerate higher temperatures, give a quicker re-entry to beat defences, have improved aerodynamic stabilization and more reliable sub-systems."

According to *Aviation Week*, another Titan C and a Titan B are scheduled to be fired before the end of the year and two Titans are due to go next month. These firings will be critical, since continued failure could adversely affect the missile's place in the overall defence scene.

PROJECT ECHO

To test the feasibility of a passive reflector communications system on a global basis is the test objective of Project Echo, reported briefly in *Flight* of December 11. Three 100ft diameter reflecting spheres, it is planned, will be placed in orbit at 1,000 miles' altitude after being launched from Cape Canaveral at an inclination of some 50 deg. Each sphere will weigh about 150 lb and is constructed of a 0.0005in thick Mylar skin coated with aluminium to provide a radio-wave reflectivity of at least 98 per cent up to frequencies of 4,000 Mc/s.

Each payload package, folded inside a 28in diameter container at launch, will be placed in orbit by a Delta vehicle. About 4 lb of water in a plastic bag will be carried inside the sphere. On injection, the container opens by means of explosive bolts and inflation of the sphere commences with the residual air inside the satellite. Inflation is completed as the water in the plastic bag vaporizes and expands.

Radio transmissions on 2,390 Mc/s and 960 Mc/s will be transmitted by the NASA/JPL Goldstone tracking station in California and the Bell Telephone Laboratory station at Holmdel, New Jersey, respectively, and each station will attempt to receive the transmission from the other, following reflection from the satellite sphere. The first launch is scheduled for "early in the spring" next year.

CRANFIELD MISSILES DINNER

Each year the College of Aeronautics at Cranfield are hosts at a dinner to meet the students currently taking the College's one-year course on guided missiles. These courses have now been running for four years and are open to students selected by friendly governments. This year 26 students took the course, from Belgium, Denmark, Holland, India, Italy, Norway, Sweden, Western Germany and Yugoslavia. The occasion has never been one for earth-shaking pronouncements; but the blending of the College's hospitality with the cosmopolitan gathering of representatives of the Services, governments, diplomatic corps, industry and academic world, rendered the event singularly enjoyable.

The launch of this Titan C at Cape Canaveral was postponed on December 10 after an automatic sequence system signalled engine cut-off. Two days later a second countdown ended in an explosion on the pad (news item on facing page)

In proposing The Guests, Prof. W. S. Hemp became charmingly confused over the rapidity with which ministries change their names; and, in replying, A.V-M. G. Silyn Roberts likewise expressed some confusion, pointing out that he was not representing the Ministry of Aviation (as the attendance list proclaimed) but the Air Ministry. A.V-M. Roberts is now director-general of engineering at that Ministry, and is uniquely able to outline the development of pilotless vehicles in this country (several of which he flew). He moralized briefly on a technical note, suggesting that most aeroplane unreliability was caused by people taking things to bits to look at them, and that it was better to let well alone.

Proposing the toast of The College, S/L. C. S. Seshadri of the Indian Air Force felt a much better citizen for having been able to comprehend the problems and hopes of his fellow-students from all over Europe. Replying, Prof. A. G. Smith outlined the work of the College during the past year. Reflecting diversification within the industry, Cranfield hopes to launch forth into non-aeronautical fields. The first such course has already started; it deals with problems of control—servomechanisms and feedback, etc. Next October an advanced school of automobile engineering should be launched with the co-operation of the Ministry of Education and the S.M.M.T. Only partly jokingly, Prof. Smith also suggested a diversified course in space technology, covering such subjects as celestial mechanics and the ecology of sealed cabins.

The proposed budget allocation for the U.S. space programme in the coming fiscal year is $800m, an increase of some $300m over the current year's amount.

A fully equipped D-model Atlas flew a successful full-range mission from Cape Canaveral on December 8, the sixth test since operational capability was achieved on August 31. The following day a Jupiter IRBM left Cape Canaveral on what also appears to have been a successful mission.

A course of twelve lectures on *Engineering Aspects of Spaceflight* will be given at the Royal Technical College, Salford, on Tuesdays at 7 p.m. beginning January 19. The course fee is two guineas; organizing lecturer is J. T. Henshaw, and associate lecturers are J. E. Allen, E. G. D. Andrews, D. E. Bailey, S/L. J. Ernsting, J. Ring, D. J. Shapland, A. K. Weaver, P. J. Wingham and P. R. Wyke.

Further delays in the programme for the Saturn space vehicle may result from indecision concerning the second stage. The committee advising NASA on the overall project may not proceed with the original plan to use a modified Titan booster. Meanwhile the first stage of Saturn is becoming hardware at Huntsville, as an accompanying picture indicates.

According to an Italian news-agency report on December 12, which quoted a "most reliable source" in Prague, four Soviet astronauts have lost their lives in unsuccessful attempts by Russia to put a man in space. The attempts were said to have been made at Kapustin Yar missile base, near Aralsk, at the end of 1957, beginning of 1958 and in January and February of this year. The Agency gave the names of the astronauts as Alexei Ledowsky, Serenty Schiborin, Andrei Mitkow and a woman, Mirija Gromov. No confirmation of the report was obtained from any other source.

Speaking in the House of Lords on December 9, Viscount Hailsham, Minister for Science, said: "I hope that within two years British instruments may be in orbit round the Earth—a statement which would have seemed astonishing a very short time ago; and I believe that the modest but well-thought-out programme which has been provided for us by the scientists will enable us to get our feet wet in the waters of space at the earliest possible moment, and with the greatest possible advantage to this country, on a scale which is commensurate with our other scientific efforts and which will command the respect of scientists throughout the world."

Project Mercury is accounting for about 15 per cent of the total NASA budget for the current fiscal year, and represents the Administration's biggest single effort at the present. This was stated by John A. Johnson, the Administration's general counsel, in Washington on December 10. The total cost of the project over a four-year period, he said, was likely to be approximately $350m. Saturn was moving ahead as a top-priority project and, during the next fiscal year, almost 20 per cent of the NASA budget would be directed towards completion of the Saturn vehicle. "Even so," Mr. Johnson remarked, "this vehicle system will probably not be available for use until the 1964-65 period."

Soviet space hardware was displayed before a Latin-American audience for the first time recently at an exhibition of Russian scientific, technical and cultural achievements in Mexico City. Exhibits seen in this picture include a Sputnik 3 replica and a model of the final stage of the rocket which carried Lunik 1

FLIGHT SYSTEM SURVEY

Radar and Fixer at Hatfield

A MARCONI S.232 50 cm surveillance radar has now been installed at the de Havilland airfield at Hatfield. The radar, which was recently inaugurated by G/C. John Cunningham during an informal ceremony, is primarily intended for plotting aircraft approaching and leaving Hatfield, but it can if necessary pass information to Luton and Radlett.

In conjunction with the S.232, Hatfield now also has a Marconi automatic V.H.F. fixer using two AD.200 direction-finding stations at Hatfield and Bedells End, near Cheltenham. The bearings taken automatically when an aircraft transmits on the appropriate frequency are displayed together as intersecting lines on a 17in cathode-ray tube bearing a translucent map of the area. In this way an aircraft's position may be instantly fixed and its trace on the radar tube identified without procedure turns.

The AD.200 unit at Bedells End is remotely controlled from Hatfield over a V.H.F. radio link. The link receiver near Cheltenham is permanently on and a coded two-tone signal is transmitted from Hatfield to switch on the AD.200. A second coded sequence will change the AD.200 frequency to another channel and a third will switch the equipment off again. Further coded tones can control a field test oscillator near the AD.200 to take test bearings to check its accuracy.

Transistorized Power Supplies

NEW transistorized power supplies giving pure wave-forms at high efficiency have been announced by the telecommunications division of Elliott-Automation Ltd. The new units could be used in place of rotary machines; and transistor power-packs in the same range could replace vibrator inverters providing square-wave a.c. or high-voltage d.c. Power limitations of the new transistor units are rapidly being overcome with new heavy duty transistors.

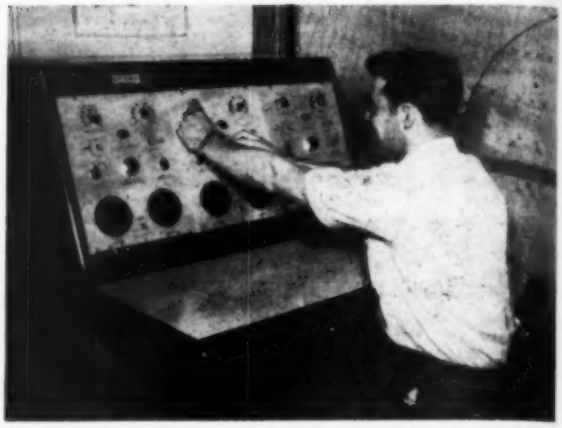
Ferranti Orion

CONSTRUCTION of the prototype of one of the fastest and most powerful high-speed data-processing systems in the world is now under way at Ferranti Ltd. Called Orion, the new system is fully transistorized and incorporates the latest Neuron logical elements allowing complex systems to be built around the central computer with the minimum of components.

In order to keep so large a machine working at full capacity, full facilities are provided in Orion for automatically sharing the time of the central computer between several programmes. Time-sharing keeps the computer fully engaged even while peripheral transfers take place and peripheral equipment is kept working at maximum speed. Fully automatic priority processing of programmes is employed. Automatic safeguards in the form of lock-ins and lock-outs prevent interference between programmes and an unusually large number of different devices may be attached to the computer. Transfer of information to and from peripheral units can be made without using buffer stores.

The magnetic-core working store can accommodate between 1,024 and 16,384 words, according to requirements, and is backed by magnetic-drum units treated as peripheral devices. Speeds will be 36 to 68 microsec for addition and subtraction, 60 to 200 microsec for multiplication and 300 to 900 microsec for division. Up to 4.5 million words will be read or written from magnetic tape in a minute and various high-speed printers may be attached. Orion will be smaller than Perseus, but 20 times as fast; and it will be three to four times as fast as Mercury. According to its size and scope it will cost between £100,000 and £300,000.

The automatic fixer display for the two Marconi AD.200 D.F. units used at Hatfield in conjunction with a Marconi S.232 radar



One of the Philco three-track radar simulator units operated by Federal Electric on the DEWline radar chain in Canada

DEWline Simulator

FOR the Federal Electric Corp., which operates the DEWline radar chain across northern Canada and Alaska for the U.S.A.F., Philco have produced a radar target simulator which is being used for training and practice at DEWline stations. Each console can produce three targets under the control of a single operator and costs $10,000. The targets may be displayed on the operational radar tubes and an accelerated time-scale azimuth gating circuit provides for uniform, accurate and continuous simulation of aircraft at short or long ranges. The simulator has also been used in the development of track-while-scan systems.

Electronics by Saab

FIRE-CONTROL systems, autopilots, missile navigation and guidance equipment and other aeronautical and industrial electronics projects now occupy the electronic sections of Saab in Sweden. There are three main centres, the equipment division at Jönköping which is the oldest, the system engineering department at Linköping and the electronics laboratory at Gothenburg; the Jönköping department produces the BT9 toss-bombing computer, also made under licence in America as the M2. The BT13 hit indicator and a variety of autopilots for fighters and missiles are also the responsibility of Jönköping. Fire-control systems, including the S6 and S7, are produced at Linköping, of which the Gothenburg laboratory is a branch.

For some years Saab has been operating its own digital computer facility called SARA and it has one of the largest technical programme libraries in Europe. There is also an analogue simulation centre mainly for weapon system studies. The company has also designed its own electro-mechanical, electrical and electronic measuring equipment and a test data processing system.

The S6 fire-control provides visual aiming information for the pilot in a conventional gun-sight deriving data from tracking radar and an infra-red detector in a streamlined fairing attached under the nose or wing of the aircraft. A ballistic computer receives range, air data and attitude signals and generates for the armament selected—guns, rockets or missiles—the currents necessary to precess the computing gyro in the sighting head. The function generating servos each have a series of non-linear potentiometer cards along which wipers are driven by a common motor. The S7 is a collision-course fire-control for the Draken intercepter.

Philco High-speed Data Link

A HIGH-SPEED air-to-ground, digital telemetry data link has been developed by the government and industrial division of the Philco Corp. for commercial use. The equipment consists of an airborne frequency-modulated transmitter and aerial and a high-gain, remotely aligned receiving aerial and low-noise, ultra-stable frequency-modulated receiver. In the 1,435-1,535 Mc/s microwave telemetry band the equipment transmits multiplexed binary-coded information at a maximum rate of 1,000,000 bits/sec. Range is 100 miles at 5,000ft.

The Philco telemetry unit was designed as part of an airborne digital data-handling system for use in testing of the Douglas DC-8. Preliminary flight trials have been completed.

Holiday-makers view Christmas scenery from the un-Dickensian cosiness of a Dart Herald's cabin.

Handley Page
wishes you a Merry Christmas
and a Happy New Year

P531 HELICOPTER

The P.531 is designed to meet the demand for a compact, turbine powered, general purpose helicopter. Good performance and carrying capacity, versatility and ease of servicing are features of this functional aircraft. The P.531 is on order for the Ministry of Aviation for the Royal Navy.

The P.531 illustrated above is powered by the Blackburn A.129 engine.

The P.531 is being developed for use in the following roles:

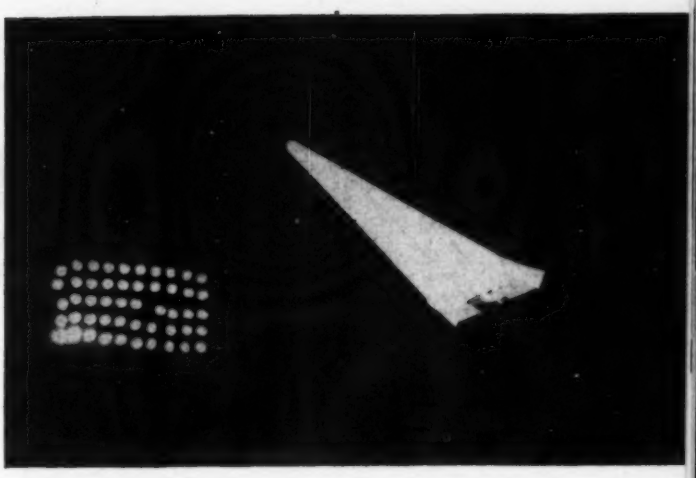
ANTI-SUBMARINE SEARCH & STRIKE
AIRBORNE SUPPLY · LIAISON
TRAINING · AIR/SEA RESCUE
CASUALTY EVACUATION
LIGHT FREIGHTER · RECONNAISSANCE

It is designed to accept a choice of engines in the 1,000 h.p. range derated to 650 h.p. thus giving it a performance largely unaffected by climatic conditions and altitude.

SAUNDERS-ROE

CPW/289/23

HELICOPTER DIVISION · SOUTHAMPTON AIRPORT · EASTLEIGH · HANTS · ENGLAND



One of the many configurations studied is the slender delta. This example is being tunnel tested by the U.S. National Aeronautics and Space Administration, in an open-jet tunnel at the Langley laboratory

HYPERSONICS

Vehicles Intended for Controlled Flight at 15,000 m.p.h. : Some British and American Suggestions

EARLIER this year a Symposium on Hypersonic Flow was sponsored by the Colston Research Society, and held at the University of Bristol. From the many papers there presented, we have chosen two for abstraction in order to provide an outline of the type of craft which may become familiar within 20 years.

The first paper was presented by H. Metcalfe of the G.W. aerodynamics department, Bristol Aircraft. He opened his paper by postulating generally accepted limits for sustained flight at about 15 to 40 lb/sq ft wing loading and equilibrium skin temperatures of 1,000 to 1,200 deg K for steel airframes. In certain circumstances, ablation, insulation, heat-sink or refrigeration techniques enable reasonably sustained flight to be achieved at higher skin-temperatures. Strategic ballistic missiles penetrate the equilibrium skin-temperature limit on re-entry. A range of low-altitude flight conditions is shown in Fig. 1.

Glide and skip vehicles for space-ferry missions (Fig. 2), do not need aerodynamic lift over parts of the trajectory—for instance, when the glide vehicle is spiralling in, and when the skip vehicle is moving along a ballistic trajectory. The glide vehicle would presumably be so designed that the equilibrium temperature would be marginally inside the limits shown for reference; the skip vehicle is a more severe case, but the high-temperature condition is transient.

In Fig. 3 is shown the standard flight envelope for sustained flight with air-breathing power units and, superimposed, a possible envelope for anti-missile missiles where insulation techniques for the main structure are an economical proposition. Table I summarizes characteristics for eight types of vehicle.

In hypersonic flight, a good initial lifting capability is achieved with a thick wedge-type wing, and high aspect ratio is not important. Hypersonic vehicles can thus best be formed out of simple shapes such as cones and wedges, the whole volume being used for payload. A whole family can be constructed from simple transformations of the basic forms of sphere, cylinder, or cone (Figs. 4 and 5). Certain characteristics depend on cross section as well as planform; in particular, stability requirements may well lead to a distribution of the total volume so that a quasi-body appears as part of one surface of a wing.

Lifting capability for a given body volume (and hence roughly for a given weight) for a family of simple shapes is shown in Fig. 6. The effects of section stand out compared with those of planform. The results shown are for a nominal 30 deg

Fig. 1. Flight regimes for ballistic missiles

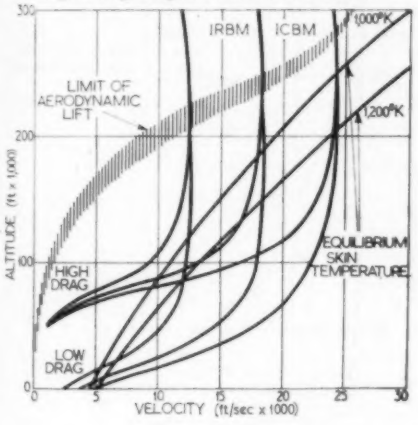


Fig. 2. Flight regimes for skip and glide vehicles

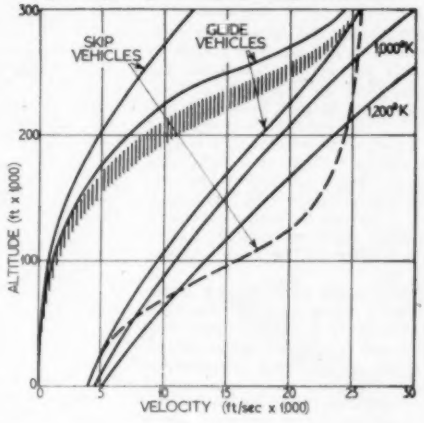


TABLE 1: CHARACTERISTICS FOR SIX TYPES OF VEHICLE

	Heating	Order of weight (lb)	Design altitude (ftx1,000)	Max. C_N	C_{D_0}	Max. C_{D_i}	L/D	Manned	Normal (lift.) 'g'	Longitudinal (decel.) 'g'
Ballistic re-entry:										
Low drag	Very severe	10^1-10^4	40-100	Z	S	Z	Z	No	Z	VL
High drag	Severe	10^1-10^4	70-150	Z	L	Z	Z	No	Z	VL
Skip vehicles:										
Long range	Intermittently severe	10^1-10^5	100-250	VL	M	L	L	No	L	M
Orbital re-entry	Intermittently severe	10^4-10^5	150-300	VL	M	VL	S	Yes	L	M
Glide vehicles:										
Long range	Moderate	10^3-10^5	180-240	L	M	M	L	No	S	S
Orbital re-entry	Moderate	10^4-10^5	200-300	VL	M	VL	S	Yes	S	M
Sustained flight	Moderate	10^5-10^6	80-150	M	S	M	L	Yes	S	VS
Anti-aircraft and anti-missile missiles	Possibly severe for short time	10^3-10^4	40-100	L	S	M	M	No	VL	L

Abbreviations: Z, zero; S, small; M, moderate; L, large; VL, very large.

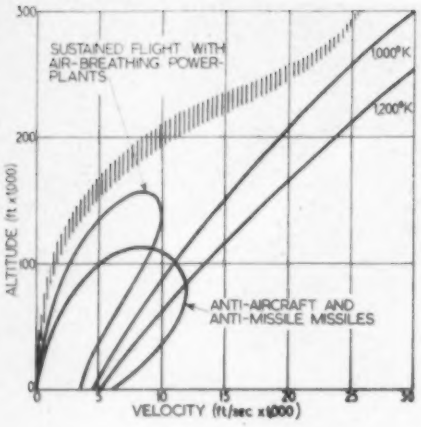


Fig. 3 (far left). Flight regimes for sustained flight and anti-missile missiles

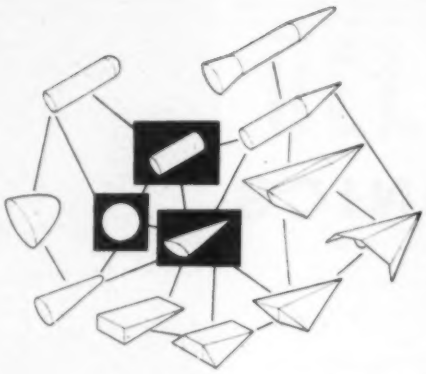


Fig. 4 (left). Possible types of configurations for hypersonic flight

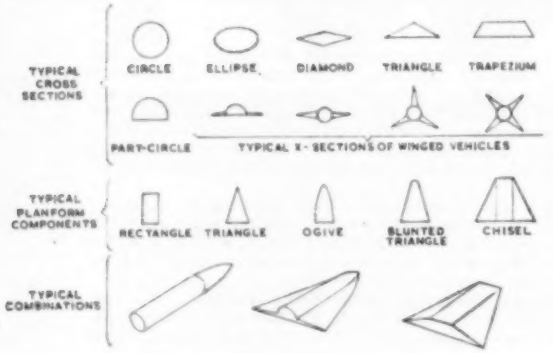


Fig. 5 (lower left). Geometrical variants of possible configurations

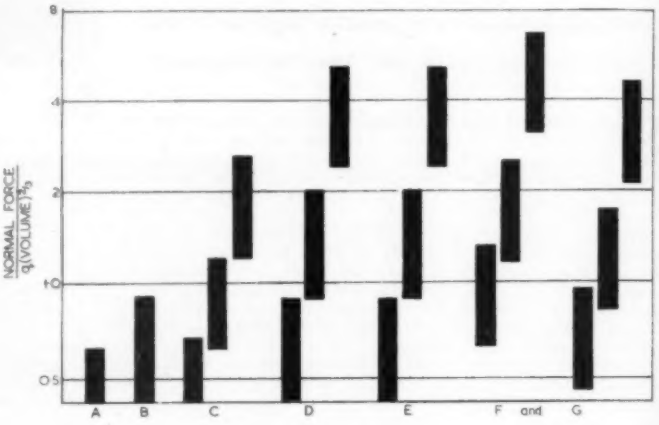


Fig. 6 (below). Normal force coefficient for various configurations (α = 30 deg., fineness ratios from 1 to 10; A, blunted cylinder; B, cone/cylinder; C, increasingly slender cones; D, increasingly slender delta wings; E, progressively thinner wedges; F, aircraft-type and G, triform-type wing/body combinations

HYPERSONICS . . .

incidence and fineness ratios from 1 (at the bottom of each hatched area) to 10, where fineness ratio is defined as length to maximum span. At first sight this appears to contradict the conclusion that thickness is a virtue from the viewpoint of high lift, but this is not so. The variations of lift/drag ratio with lift, for a 10 deg semi-angle cone and a 5 deg semi-angle wedge, are shown in Fig. 7. This illustrates what can be achieved for shapes with similar volume-carrying capability. There is a large difference in the maximum value of lift/drag ratio, and in the case of a wedge (the replacement of the conventional wing) the actual peak is a function of detail design. The high C values necessary for re-entry glide vehicles are rather more insensitive; Fig. 7 shows differences between surfaces having circular cross sections and flat under-surfaces.

As regards stability, the high nose angle cone is very stable with the projection of surface pressure acting near its base. The cone/cylinder is very unstable, particularly at low incidence, but the addition of a flare remedies this and produces a better centre-of-pressure margin than by using fins. The wedge is essentially unstable. Although configurations giving small margins of control stability can be achieved, peculiar non-linearities in c.p. may occur over wide incidence ranges. The nose shock may interfere with a flared base at moderate incidences, and a sharp increase in stability is then likely above a critical incidence. It is essential to test overall airframe shapes. Stability characteristics may be modified appreciably by camber; a convex lower surface will tend to give a c.p. well forward at low incidence, moving aft as incidence is increased (this will assist trim at a given angle).

With integrated designs at appreciable angles, any lateral stabilizing characteristic will be interfered with, and shielded by, the vehicle. Cruciform or triform designs will produce serious cross-coupling effects, due to the greater increased shadowing on the trimmed leeside.

Aerodynamic Control. Many controls used on two-dimensional shapes have their counterparts on axi-symmetric shapes—rear flaps, split flaps, unswept spoilers and leading-edge controls (Fig. 8). When trimming a stable vehicle at a positive angle of attack, the controls must produce a nose up pitching moment—i.e., rear controls must supply a download. In hypersonic flow, split flaps and spoiler controls on the upper surface of a wing or body are so shielded as to be ineffective. On the lower surface, split flaps may provide enough force if the wing is sufficiently thick to allow

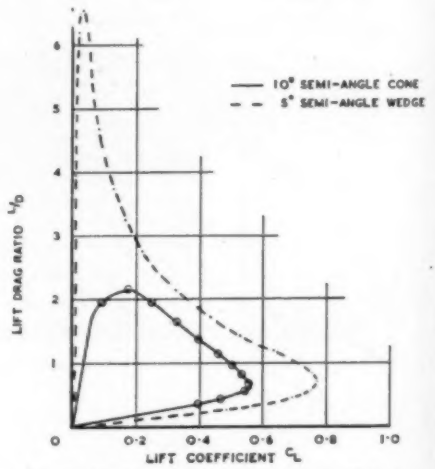


Fig. 7. Lift/drag ratios against lift coefficient

for inward movement of the control. Spoiler controls have no application in this connection. Plain flaps can be used, but their characteristics are very non-linear. In the case of an axi-symmetric vehicle stabilized by a flare, control can be obtained by moving the complete flare. The control forces on plain flaps and moving-flare controls may well be large, involving difficult engineering problems.

The most effective aerodynamic control is the leading edge or moving-nose control. This does not suffer from shielding, and Reynolds-number effects are minimized; but aerodynamic and heating loads are severe. To avoid the problems due to shielding and thick boundary layers which limit the usefulness of rear controls, tip controls and all-moving wings may be used. The moving-cone-tip control may well have structural, aerodynamic and heating advantages over a conventional flatplate. On a conventional vehicle, such as a cone/cylinder, the advantages of body flaps and flares over all moving wing-type controls increase with Mach

number, and flares are considerably more effective at high Mach numbers. None of the controls so far considered can supply roll control. Swept spoilers can do this, and give extra pitching moment.

A comparison of control types on a typical cone/cylinder/flare configuration shows that for a 2 per cent static margin, moving noses, flares, or flaps in flares might be effective up to 30 deg incidence; swept spoilers would suffice up to 20 deg and plain spoilers only up to 10 deg.

Temperature Environment. To attain extensive regions of laminar flow, and thus a relatively low heating-rate, vehicles should be designed to operate at sub-critical Reynolds numbers. Increases in the altitude above that required to ensure laminar boundary layers can still result in a further reduction of heat transfer rates.

To achieve tolerable heating rates on a wing it is desirable to combine sweepback with a rounded leading edge, both of these factors contributing to a reduction in heat transfer rate. Excessive sweepback, however, tends to increase boundary-layer instability, and thus accelerate the onset of turbulence which would result in an increased heat transfer. Also, the advantage of increasing nose radius is offset against the increase of pressure drag.

In practice, local areas sustaining high heat transfer rates may occur. A typical case is illustrated in Fig. 9, which shows a trapezoidal wing at incidence with leading-edge flow separation. It can be seen that the hot air from the undersurface boundary layer re-attaches to the upper surface, producing a cross-flow stagnation line and consequent high heat transfer rate. In configurations with significant incidences the under-surface has a higher heating rate. Erosion could conceivably lead to a change in handling.

Curves of constant normal force coefficient are given in Fig. 10. This may be used in conjunction with Figs. 1-3 to indicate the roles for which different configurations might be of use.

Skip vehicles. Assuming weight 1,000 lb, $n=10g$, 150,000ft altitude and velocity 12,000ft/sec, Fig. 10 gives a required normal force coefficient of 5-10, implying fairly large wings, especially when reasonably high L/D is required. For orbital re-entry, interpolating between the 1,000 and 1,000,000 lb lines—with n approaching 10g, altitude 200,000ft, and velocity 20,000ft/sec—gives a normal force coefficient of 20-50, implying very large wings or thin wedges.

Glide vehicles. Long range weight 1,000 lb, $n=1g$, 12,000ft/sec and 200,000ft altitude gives a normal force coefficient requirement of 5-10. For orbital re-entry, interpolating between 1,000 and 1,000,000 lb, $n=1g$, 250,000ft at 20,000ft/sec, requires a coefficient of 20-50. Thus both skip and glide vehicles would appear to have similar requirements, apart from heating considerations.

Sustained flight. Weight 100,000 lb, $n=1g$, 130,000ft at 7,000ft/sec requires a normal force coefficient of about 7, calling for a very large wing and low wing loading.

Anti-aircraft and anti-missile missiles. Weight 1,000 lb, n greater than 10g, 50,000ft at 10,000ft/sec, requiring a normal force coefficient of about 0.2. The incidences implied are probably high, hence Fig. 10 can be used direct and shows that fairly low fineness-ratio cone/cylinders or cones would suffice.

Suggested configurations and their characteristics are shown in Fig. 11. They are meant only to highlight the main differences, and should not be taken too seriously. The first configuration simply indicates the type that gives minimum drag/mass ratio, the second that which gives a high drag/mass ratio probably combined with a heat-sink forward surface. The configurations for orbital re-entry require high incidence for low L/D, convex lower surface for stability and a cabin protected from heating. Probably the only difference would be that the skip vehicle would have a heat-sink surface. The last configuration, for anti-aircraft and anti-missile missiles, would perhaps be a cone/cylinder/flare, a robust shape for use at moderate altitudes under severe manœuvres.

All the other configurations match requirements of large lifting surfaces. Those for skip and glide vehicles probably need to cover a larger Mach and incidence range, and probably a basic delta shape would be best. For sustained flight the engines would almost certainly be ramjets, probably placed beneath the wing in order to use wing incidence to aid pressure-recovery. (They may or may not extend the full length of the wing, depending on the engine-size required). A flat rectangular undersurface may be the optimum for large L/D, but may lead to control problems.

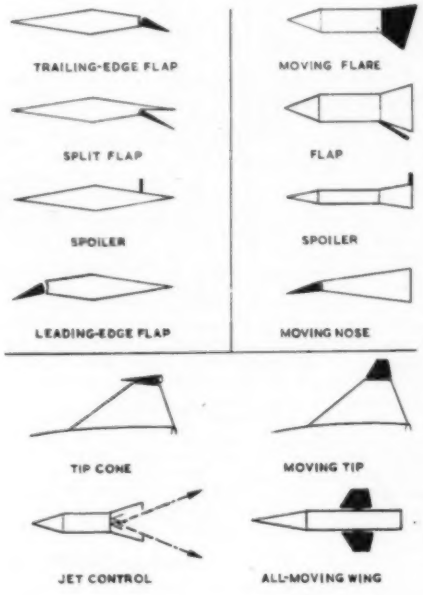


Fig. 8. Types of control

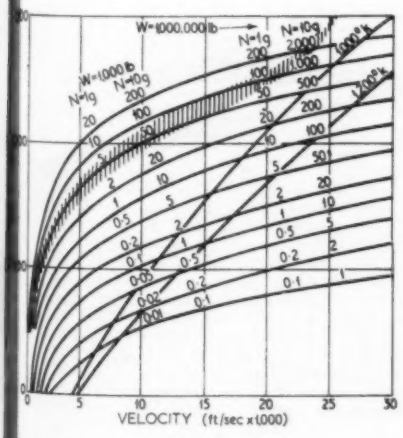


Fig. 10 (left). Lines of constant normal force coefficients for various parameters

Fig. 9. Leading-edge separation on wedge wing showing accumulation of hot air from undersurface boundary layer over the reattachment line on the upper surface

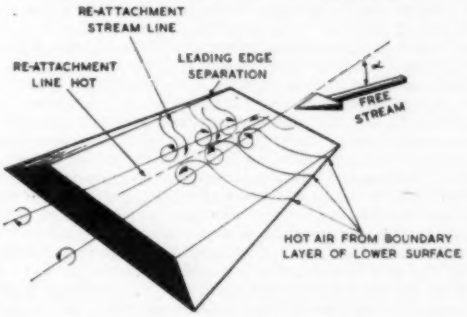


Fig. 11 (below). Aspects of hypersonic vehicles

		MANNED	NORMAL g	LONG g	MAX C_N	C_{D0}	MAX C_D	L/D	SEVERITY OF HEATING	WEIGHT lb	DESIGN ALTITUDE (ft x1,000)	
BALLISTIC RE-ENTRY	LOW DRAG	NO	O	5	O	2	O	O	5	10^3 10^4	40 100	
	HIGH DRAG	NO	O	5	O	4	O	O	4	10^3 10^4	70 150	
SKIP	LONG RANGE	NO	4	3	5	3	4	4	(4)	10^3 10^5	100 250	
	ORBITAL RE-ENTRY	YES	4	3	5	3	5	2	(4)	10^4 10^5	150 300	
GLIDE	LONG RANGE	NO	2	2	4	3	3	4	3	10^3 10^5	180 240	
	ORBITAL RE-ENTRY	YES	2	3	5	3	5	2	3	10^4 10^5	200-300	
SUSTAINED FLIGHT		YES	2	1	3	2	3	4	3	10^5 10^6	80 150	
AA&AM MISSILES		NO	5	4	4	2	3	3	(4)	10^3 10^4	40 100	

HYPERSONICS . . .

A rather longer paper was contributed by A. J. Eggers Jr., of the Ames Laboratory of the U.S. National Aeronautics and Space Administration. He opened by suggesting that the hypersonic glider may be an attractive long-range aircraft.

A boost/glide trajectory is shown schematically in Fig. 12. In the boost phase relatively little range is achieved, while speed and altitude are increased in such a manner that at the end of boost the sum of aerodynamic lift and centrifugal force (due to the curvature of the flight path) just counterbalance weight. The majority of the weight is supported by aerodynamic lift at speeds less than about three-fourths minimum satellite speed (i.e., 18,000ft/sec) while the majority of the weight is supported by centrifugal force at higher speeds. This fact is fundamental.

Variation of maximum speed with range, of gliders developing lift/drag ratios from 1 to 6, is shown in Fig. 13. Increasing L/D reduces the speed required for a given range—substantially, for ranges of the order of one-fourth the circumference of the Earth, but by decreasing amounts for longer ranges to the point where the reductions are relatively minor at global range. Increased L/D reduces the ratio of take-off mass to glider mass; but this reduction, like the reduction in velocity, is largest at ranges less than semi-global and falls off with increasing range.

The most promising technique for minimizing the quantity of heat which must be absorbed by a hypersonic glider type is to radiate it from the surface at a rate approaching, if not equalling, that of the convection process. For a vehicle with L/D=1, calculations have shown that increasing L/D may markedly reduce unit area heating (and hence heat absorbed) at ranges less than one-fourth the Earth's circumference, whereas at longer ranges it increases this heating (particularly at semi-global distances and above). At ranges up to one-fourth the Earth's circumference the large velocity reduction with increasing L/D does, in fact, tend to dominate the heating problem. At longer ranges the reduction in velocity due to increased L/D is substantially smaller, and the fact that the lower-L/D vehicles fly at higher altitudes in thinner air to achieve a given range is the dominant factor, with the result that they experience substantially less heating.

Since increased coolant means decreased payload, high-L/D configurations have relatively attractive payload capabilities in hypersonic flight over intercontinental distances. Over longer distances increased L/D loses much of its effectiveness in increasing glider mass, and payload may actually have to be reduced in order to accommodate more coolant.

High-L/D Configurations

An aircraft developing high L/D ratios will be slender, and will develop these ratios at small angles of attack. The body should, of course, have low pressure-drag and be shaped (as far as possible) to achieve high in-flight stability. Bodies in which the cross-section area continually increases from nose to tail have the virtue of low drag at hypersonic speeds, along with the flare effect which contributes to stability. For simplicity, one may consider such a body of revolution mounted symmetrically on a thin wing at zero angle of attack. A front view of this arrangement, along with the disturbance velocities created by the body, is shown at the top of Fig. 14. In order to achieve high L/D, the components of an aircraft should be individually and collectively arranged to impart the maximum downward and the minimum forward momentum to the surrounding air; the upper half of the body should therefore be eliminated. The wing now serves the important function of preserving the downward momentum of the air disturbed by the lower half of the body. The elementary momentum principle suggests that the wing leading edge should coincide with the shock wave created by the body. The wing should extend downstream toward, but not beyond, the line along which the body ceases to impart downward momentum to the fluid. Accordingly, the wing trailing edge should, like the leading edge, be swept back and it should join with the body at its base. The configuration shown on the lower right of the figure satisfies the condition of high leading-edge sweep to minimize heating in this region, and the low aspect ratio is favourable to minimizing structural weight.

Something more may be learned, however, by again viewing the configuration from the front. Such a view is shown in the upper left of Fig. 15. It is observed that the body imparts lateral as well as downward momentum to the surrounding air. According to the momentum principle, this lateral momentum should be converted into downward momentum, and this may be done by deflecting the wing tips downward about hinge lines in the stream direction (as shown in the upper right). In this location the drooped tips can serve two functions. One, of course, is to increase lift. Also, and perhaps more important, they are suitably located to provide directional stability and control for the configuration. This gives the crude semblance of a complete aircraft configuration, of the flat-top type with a laterally symmetric fuselage.

The most important question is, of course, do configurations of this type actually develop high L/D at hypersonic speeds? Maximum L/D of flat-top conical configurations have been calculated for high Mach numbers. In the calculations, base drag was neglected and a 5 deg half-cone body was used. The wing trailing edges were formed by straight lines swept back from the body base and intersecting the leading edges 1.4 body lengths aft of the vertex.

Plan-form changes with design Mach number. With increasing Mach number and skin friction, there is a reduction in maximum L/D. But if skin-friction cofficients are less than 0.006, the flat-top configurations should be able to develop maximum L/d of the order of 6, if not greater, at Mach numbers up to 10. The flat-top configurations are consistently capable of achieving higher L/D than corresponding flat-bottom configurations, and this advantage increases substantially with decreasing friction drag. Some measured maximum L/D for this type of configuration are shown

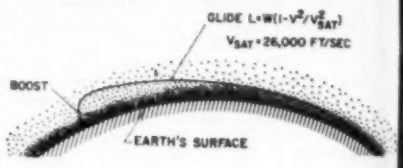


Fig. 12. Boost/glide flight trajectory

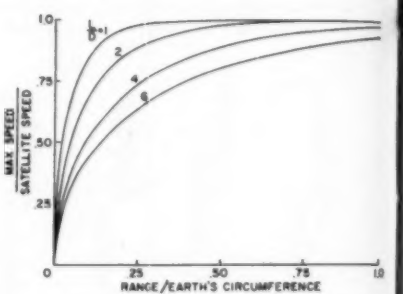


Fig. 13. Variation of speed with range

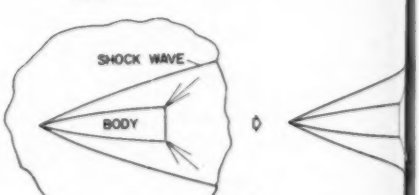


Fig. 14. Evolution of flat-top wing/body combination

Fig. 15. Evolution of flat-top aircraft configuration

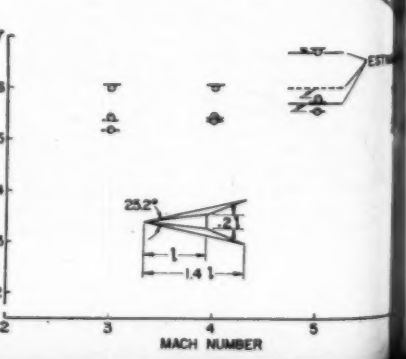


Fig. 16. Measured maximum lift-drag ratios

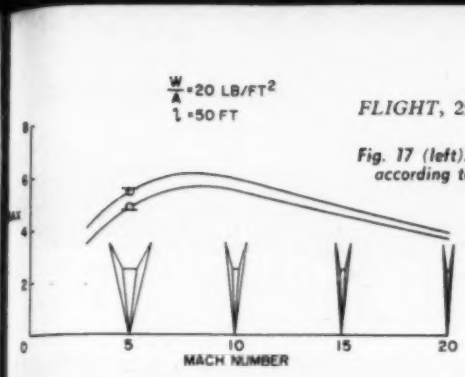


Fig. 17 (left). Lift/drag ratios according to similarity rule

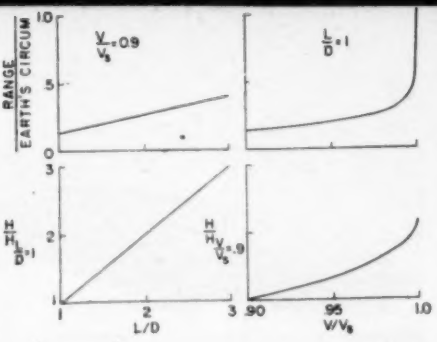
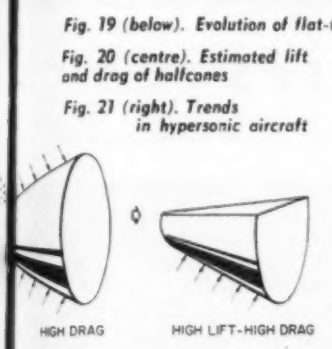


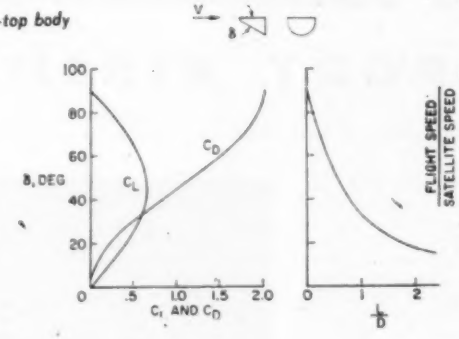
Fig. 18 (right). Range and heating of sub-satellite

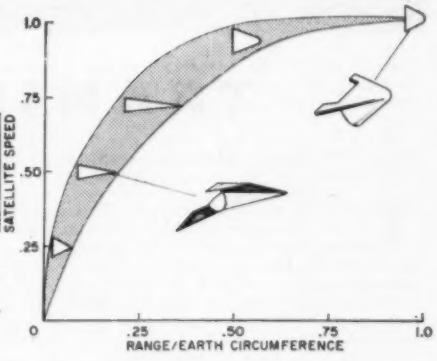
Fig. 19 (below). Evolution of flat-top body

Fig. 20 (centre). Estimated lift and drag of halfcones

Fig. 21 (right). Trends in hypersonic aircraft







in Fig. 16. The flat-top configuration has the highest L/D over the Mach-range chosen, and at the design Mach number of 5 this ratio is only slightly less than 7, exceeding the flat-bottom L/D by more than 15 per cent and the symmetrical configuration by over 20 per cent. At the design Mach number, theory and experiment are in essential agreement.

Increasing the wing-tip droop angle was found slightly to decrease L/D for a slender configuration with sharp tips, whereas with a blunter configuration, having tips cut off normal to the flight direction, L/D at first increases and then decreases.

Estimated maximum L/D over a wide range of Mach numbers are presented in Fig. 17. Base-pressure coefficients equal to 70 per cent of the vacuum value were assumed. The resulting base drag is the principal cause of reduced L/D at Mach number below about 7. At Mach numbers from 7 to 10, highest flat-top L/D are achieved (of the order of 6). With increasing Mach number above 10 there is a steady decline down to about 4 at M 20. This decline occurs in spite of the increased slenderness of the vehicles, and it is due to the combined effects of decrease in lift-curve slope and increase in the proportion of total drag which is friction drag. Accordingly, while flat-top configurations tend to retain their advantage in lifting efficiency at Mach numbers approaching 20, this advantage is small; it applies to reduced values of L/D; and it tends to be achieved with configurations which may be impracticably slender. Low-L/D vehicles may be preferable here.

Low L/D Configurations

Range and heating per unit area of sub-satellites are shown in Fig. 18. The results shown on the left of the figure are for a maximum glide speed equal to 0.9 satellite speed, and the independent variable is L/D. The results shown on the right are for an L/D of 1, and the independent variable is maximum glide speed. Increasing L/D from 1 to 3 at 0.9 satellite speed will not even provide semi-global range, whereas increasing the speed by slightly less than 10 per cent to near satellite value will easily provide semi-global range, or more. Of further importance is the fact that the heating penalty associated with this speed increase is far less than that associated with the increased L/D.

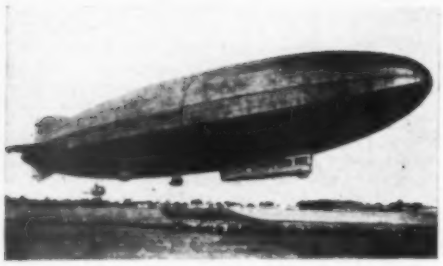
Lift-drag ratio is important for other reasons related to decelerations and lateral manœuvrability. Sub-satellite vehicles developing L/D near 1 are characterized by adequately low decelerations and adequately high lateral manœuvrability.

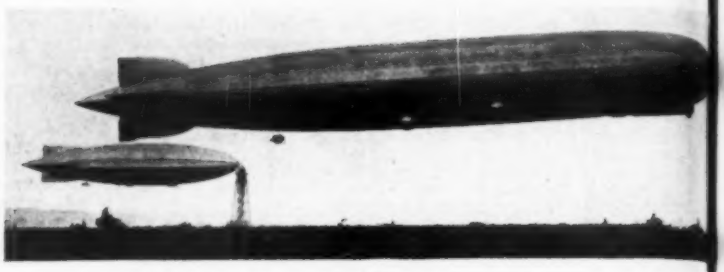
A high-lift, high-drag configuration for sub-satellite applications can be derived by removing the upper half of a blunt body of revolution (Fig. 19). The lift and drag of half-cones, calculated by Newton's impact theory, are shown in Fig. 20. Drag coefficient increases continuously with increasing cone angle while lift coefficient reaches a maximum at a cone angle of 45 deg. As a result, L/D decreases with increasing cone angle from a value near 2 at 20 deg to zero at 90 deg. Heating per unit area increases markedly with increasing L/D, approaching values like 80,000 B.Th.U./sq ft in the stagnation region and 40,000 on an average surface element at an L/D of 2. Therefore L/D should be no higher than that required by considerations of deceleration and manœuvrability. Equilibrium surface temperatures are observed to decrease somewhat with increasing L/D, being generally a little under 3,000 deg R. This is within the range of useful strengths of ceramic, if not high-temperature structural, materials: and radiation cooling should—indeed must—be achievable to a high degree. Even a small percentage of the heat load may amount to several thousand B.Th.U./sq ft of surface area, and so the coolant required can add several pounds per square foot to an already relatively heavy structure.

One method of converting a half-cone body to something resembling a flyable sub-satellite is to locate a small wing on top of the body, the portion of wing aft of the base being hinged to act as elevons. Stability about all three axes is derived primarily from the body, while damping in roll comes mainly from the wing. Generous nose-bluntness and filleting at the wing/body junction are provided to minimize heating problems in these regions. Experimental results, confirming Newtonian theory, give some assurance that high-lift, high-drag configurations of the flat-top type developing L/D of the order of 1 may be designed with suitable flying qualities at supersonic and hypersonic speeds. If the configurations are blunt to the degree of the one shown on the extreme right of Fig. 21, it seems unlikely that they will be capable of a conventional landing. If a conventional landing capability is important, then basically more slender configurations which can develop higher L/D at low speeds may be necessary. It is essential, of course, to minimize hypersonic heating. In the sub-satellite portion of flight the vehicle flies at a high angle of attack, giving it apparent asymmetric bluntness to provide high lift and high drag. As speed is decreased and the trajectory steepens, the angle of attack of the vehicle is reduced to a value giving high L/D. The sinking speed is thereby reduced to allow normal landing.

Summarizing, the trends of hypersonic aircraft configurations with increasing speed and range are shown schematically in Fig. 21. The shaded area represents the speed/range corridor for the glider-type aircraft. The boundaries of this corridor are largely determined by the requirement for reasonable payload. Flight above the upper boundary markedly decreases payload, because L/D becomes so low as to require excessive take-off mass for a given glider mass. Flight below the lower boundary has the same result at longer ranges because L/D becomes so high as to cause excessive aerodynamic heating, with the result that substantial coolant must be provided to protect the vehicle. Flight below the lower boundary at shorter ranges is unattainable with known techniques for obtaining high L/D.

The configurations that tend to fly within these boundaries are shown schematically in the shaded area. At first they increase in slenderness with increasing speed and range in order to maintain high L/D. At speeds up to about 18,000 feet per second, configurations with the body situated entirely beneath the wing may develop high L/D and may be evolved into something resembling a complete aircraft configuration by drooping the wing tips. Configurations for higher-speed, longer-range flight may also have a flat top to provide high lift to decrease heating rates, along with high drag (by blunting) to reduce total heating.





TRANSPORT AIRSHIPS

A Short-lived Dream : their Economics Examined

By PETER BROOKS

THE airship—particularly the rigid airship—was much canvassed during the first 40 years of the twentieth century as the most promising vehicle for long-haul air transport. In the event, heavier-than-air machines have emerged as the significant transport aircraft; and the airship, after a brief and limited career as a scheduled-service vehicle, has faded from the scene. There can indeed be few major technical developments which in their time attracted so much public attention, as well as devotion and sacrifices from their proponents and expenditure and effort by Governments and private enterprises but which, in the end, produced so little practical return.

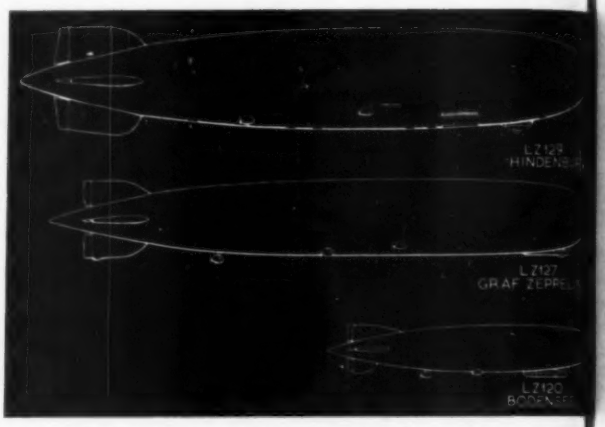
Three rigid airships were used for scheduled services for short periods between the wars. All three were German Zeppelins. The first extensive passenger-carrying by airship was done in Germany by the DELAG company, using several small Zeppelin rigids in the years 1910-14. About 17,000 passengers were carried on over 800 flights. These operations are, indeed, sometimes claimed as the first airline operations but, in fact, they were not scheduled transport services for the carriage of passengers or freight from one place to another. They were more in the nature of joy-rides or cruises undertaken for the experience of the flight itself and were not properly maintained to a published timetable.

In the latter part of 1919, however, the Zeppelin company did use its small LZ *Bodensee* rigid of 800,000 cu ft capacity to run a tentative scheduled service between Friedrichshafen and Berlin —a distance of 375 miles, which was covered in about six hours. The service was started on August 24 and was maintained for three months, during which time 2,450 passengers were carried on 103 flights. Operations were stopped on December 1 by restrictions imposed by the Inter-Allied Control Commission. The next scheduled service by airship was that established, also by the Zeppelin company, between Friedrichshafen (later Frankfurt) and Rio de Janeiro in South America in March 1932 and maintained on a nine to 20 round trips per summer season basis until 1937. The journey time was between 80 and 120 hours for a distance of about 6,000 miles. The famous rigid, the LZ 127 *Graf Zeppelin* (first flown in 1928) was mainly used for this service, although it was supplemented by the newer and larger LZ 129 *Hindenburg* during 1936 and 1937. The *Graf Zeppelin* was also used for a number of proving flights over the North Atlantic and the *Hindenberg* started a scheduled service—consisting of ten return flights during the summer over this route between Frankfurt and Lakehurst, New Jersey, in 1936. The average journey time was 65 hours westbound and 52 eastbound for a distance of about 4,000 miles. However, the latter operation, and all scheduled airship flying, came to an abrupt halt when the *Hindenburg* was destroyed by fire while landing at Lakehurst at the end of its first crossing in 1937. Thus ended the airship's short period of use as a transport aircraft.

During their careers, the *Bodensee*, *Graf Zeppelin* and *Hindenburg* achieved the following operating results :—

Years of scheduled operation	Airship	Hours flown	Flights made	Pass. carried	Block speed
1919	Bodensee	532	103	2,450	61 m.p.h.
1932-1937	Graf Zeppelin	17,177	590	13,310	61 m.p.h.
1936-1937	Hindenburg	3,088	63	3,059	68 m.p.h.

Only part of the above-mentioned hours were accumulated on scheduled operations, but during their peak operating period the two later airships each attained utilizations of between 2,000 and 4,000 hours per annum. Load factors of between 80 and 90 per cent are believed to have been achieved on the Atlantic routes. Indeed, the *Hindenburg* is said to have had a 100 per cent load factor on the ten return transatlantic trips made during 1936, but about 15 per cent of this total consisted of non-revenue passengers.



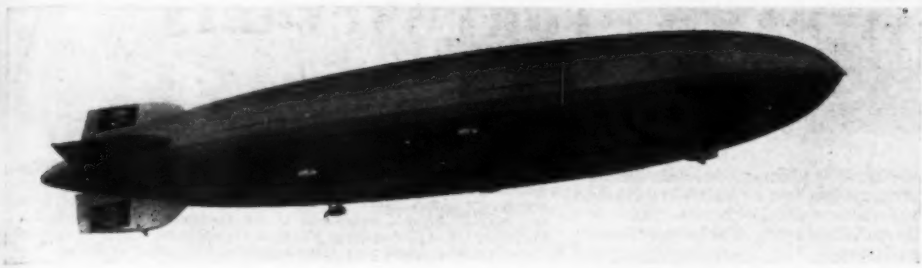
The three German airships, approximately to scale

TRANSPORT AIRSHIPS

	LZ 120 "Bodensee"	LZ 127 "Graf Zeppelin"	LZ 129 "Hindenburg"
Date of first flight	Aug. 24, 1919	Sept. 18, 1928	Mar. 4, 1936
Nominal gas volume	812,240 cu ft	3,708,100 cu ft*	7,062,150 cu ft
Overall length	394ft	757ft	813ft
Maximum diameter	59ft	99ft	135ft
Engines	Four Maybach	Five Maybach	Four Maybach
Total maximum power	4×260 h.p.	5×530 h.p.	4×1,025 h.p.
Gross lift	50,700 lb	240,000 lb	543,500 lb
Weight less fuel and payload	38,800 lb	183,000 lb	359,600 lb
Normal max. payload	6,600 lb	29,600 lb	40,700 lb
Passenger accommodation	30	20	50†
Normal crew complement	12	26	35
Max. fuel capacity	5,300 lb (petrol)	27,400 lb (petrol + "blaugas")	143,200 lb (heavy oil)
Normal cruising speed	70 m.p.h.	71 m.p.h.	77 m.p.h.
Still air range	850 st. m.	8,000 st. m.	8,400 st. m.
Probable approximate total operating cost per seat-mile (mid-1930s money values)	15 pence	12 pence	8 pence

* 2,650,000 cu ft of hydrogen capacity (the remainder being "blaugas" fuel).
† Increased to 72 passengers during 1936/37 winter.

Primitive comfort: the passenger cabin of "Bodensee"

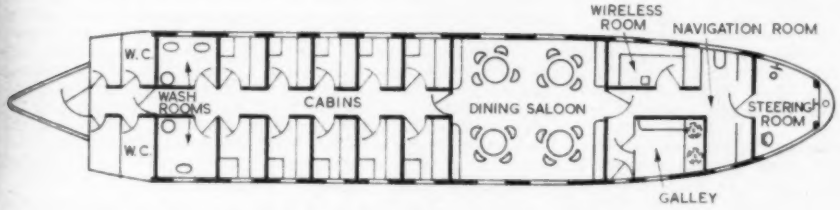


In these pictures, from left to right, are seen the "Bodensee," "Graf Zeppelin" and "Hindenburg." In the centre photograph, taken at Cardington in April 1930, when "Graf Zeppelin" visited England, the British ship R100 is seen at her mooring mast in the distance; she measured 709ft against the German ship's 757ft

Regularity of operation was good for the period but punctuality was poor: fluctuations in block time of up to 12 hours were not uncommon on the Atlantic services.

On the basis of such a limited operational record it is difficult to reach any firm conclusion on the true practicability of the rigid airship as a scheduled vehicle. However, of about 160 rigids (three-quarters of them Zeppelins) built, and almost all for military or experimental purposes, about 20 per cent were destroyed in accidents. It is true that some of these accidents, including that to the *Hindenburg*, would not have happened if non-inflammable helium had been used instead of hydrogen but, on the other hand, all three of the American rigids built came to untimely ends, although they were filled with helium. In spite of the unique career of the *Graf Zeppelin*, which with comparatively few narrow escapes from disaster flew far more hours than any other rigid, in the light of modern knowledge of the extent and strength of sengers; so, if the above figures are correct, the airship appears to have been just about capable of covering its cost of fivepence per seat-mile at 100 per cent load factor during its last season of operation, for which 18 round trips were planned.

The validity of the above cost figures is difficult to assess, but it is interesting that in 1928 Eckener had estimated that the economic single fare for the *Graf Zeppelin* on the North Atlantic route would be £600, and that this fare was charged on the early North Atlantic proving flights, being equivalent to a revenue rate of about 3s per passenger-mile. (A transatlantic fare of £400 was later charged on this airship.) If we assume that Eckener was working on an average load factor of 65 per cent—and he is hardly likely to have taken anything lower than this—the above revenue rate implies a total operating cost of about 2s per seat-mile, or nearly three times the figure claimed for the same aircraft six years later. Different assumptions in the writing-off of the aircraft and ground



Passenger accommodation and flight-deck layout of "Graf Zeppelin." All of it was contained in the forward car, visible from the ground

vertical currents in the atmosphere it is doubtful whether the rigid airship could have achieved acceptable safety standards in world-wide scheduled operation.

Some indication of the economic characteristics of the rigid airship as a scheduled vehicle in the early and mid-1930s is provided by figures given by Dr. Hugo Eckener of the Zeppelin company to the American Federal Aviation Commission in 1934. He stated that the total operating costs of the *Graf Zeppelin* on the South American service were 15 shillings per aircraft-mile. As that airship had accommodation for 20 passengers, this was equivalent (if the aircraft is regarded as a purely passenger-carrying vehicle) to a seat-mile cost of about ninepence in contemporary money values. Eckener also estimated in 1934 that the total operating cost of the *Hindenburg* on the same route would be 27s per aircraft-mile. With accommodation for 50 passengers, this would be equivalent to a seat-mile cost of 6½ pence.

In 1938 Eckener claimed that an airship like the *Hindenburg* making 15 round trips a year on the North Atlantic route (50 per cent more than were made in 1936) would have a total operating cost of about 21s per aircraft-mile, equivalent to rather more than threepence per seat-mile with accommodation for 75 passengers. In actual fact, the Transatlantic single fare charged on the Hindenburg was £80—equivalent to a revenue rate of nearly fivepence per passenger-mile—and, at this fare, the airship is said to have covered 80 per cent of its cost of operation during 1936. During the 1936-37 winter, however, the passenger accommodation on the *Hindenburg* was extended to take a total of 72 passfacilities may account for part of the discrepancy, but such calculations as can now be made suggest that Eckener's 1934 and 1938 figures were—probably intentionally—optimistic and that a more realistic estimate of the operating costs of a 1928 20-passenger rigid airship of 3,700,000 cu ft capacity, such as the *Graf Zeppelin*, over non-stop stage lengths of up to about 5,000 miles would be about 1s per seat-mile (at mid-1930s money values).

For a 1936 50-passenger airship of 7,000,000 cu ft capacity, such as the *Hindenburg*, making ten transatlantic round trips a year total costs (in the same money values) were probably more like eightpence per seat-mile. This was about the operating cost over very much shorter stages (up to about 500 miles) of, for example, the 1936 24-passenger Short Empire flying-boat and about double those of the 1935 21-passenger Douglas DC-3 landplane on 500-mile stages. The above airship costs were achieved with hydrogen as the lifting agent. Substitution of non-inflammable helium, of nearly ten per cent less lifting capacity would probably have increased these costs between 50 and 100 per cent, although the Zeppelin company was working on methods of mitigating this effect in the years immediately preceding the War.

In the event, the *Hindenburg* disaster marked the end of the rigid airship and the Second World War sealed its fate. By the time the war was over the long-range aeroplane had so developed and was in such widespread use on the long-haul air routes of the world that the much slower and, by comparison, operationally unproven rigid airship—even filled with helium, had no chance of revival.

Passengers in "Hindenburg" could look down from a promenade deck

Lighter-than-air luxury: the writing room of "Hindenburg"

MAY DAY AT FORT VICTORIA

A Rhodesian Airport Interlude

By S. G. H. WILLIAMS

THIS is the story—lightheartedly recounted by Mr. S. G. H. Williams, meteorological officer at Fort Victoria aerodrome, S. Rhodesia—of an emergency with a happy ending. It describes the impact upon a small and isolated African community of the unexpected arrival of E.A.A.C. Canadair DC-4M Argonaut VP-KOI (commander Capt. Peter Cooke) with a seized port outer engine and runaway propeller.

TO B.O.A.C. and other crews commuting between London and Johannesburg there are but two airports after Entebbe southbound, namely, Salisbury and Jan Smuts. There *are* others; but these are for the use of *les autres*, and have no significance other than a dot on the map.

Such a field is Fort Victoria aerodrome in Southern Rhodesia. Situated 150 miles south of Salisbury, it is on the direct route from Salisbury to Johannesburg and provides a non-directional radio beacon as its contribution to the facilities of the route. It is manned by one European who, although primarily employed by the Federal Meteorological Department, carries out his duties of meteorological officer, radio operator, aerodrome controller, Shell refuelling agent, aerodrome manager, fire officer, Vacuum Oil refuelling agent, information officer, aerodrome maintenance officer and provider of light refreshments with impartiality. He lives on the aerodrome in splendid isolation, and, theoretically, is available for twenty-four hours of the day on most days of the year.

It is a well-known concept that familiarity breeds contempt and, to those of his ilk toiling in their spacious, air-conditioned and upholstered offices in Salisbury and Bulawayo, the sights and sounds of large, four-engined aircraft are commonplace. Even a stately Comet taxying past the windows would occasion no remarks other than an anguished expletive from the briefing officer in the middle of a telephone conversation.

Not so in Fort Victoria. Work is carried out in a rather more tranquil atmosphere. Surrounded by b-b-b-bundu and mealie patches as it is, the total absence of noise and distractions often make it possible to distinguish the African met observer's snores, emanating from the office next door, above the mutter of the point-to-point radio and the occasional buzzing of a trapped bee on the windowpane.

At intervals, a light aircraft—usually of the Cessna or Piper breed—arrives, bringing businessmen, dam-builders, engineers, and the occasional American tourist bound for the Zimbabwe Ruins and loaded with five years' salary in photographic equipment. Even commercial air services occasionally operate their daily schedule and arrive and depart in their usual frantic rush. Other than that, however, the only view we ever have of the larger arcraft is when they float majestically overhead at their 10,000-15,000ft, bound for Johannesburg or Salisbury. It is doubtful whether the captain even looks up from his Agatha Christie to note that he is passing over Fort Victoria.

But it was rather a different story one day earlier this year—a day which will doubtless go down in the annals of Fort Victoria.

Out of the Blue

It started normally. For the first part of the morning, the officer in charge was buried quietly under a mountain of ledger sheets, returns, charts, monthly reports and unanswered H.Q. correspondence which constitutes the normal end-of-month anguish. He could have been working hard. Or asleep. Or dead. Or merely dreaming of his long-awaited leave. It is a moot point. But tea-time was looming on an otherwise black horizon when the information was received on the point-to-point radio that an East African Airways Argonaut, en route from Jan Smuts to Salisbury, was in trouble and wished to make a forced landing on Fort Victoria aerodrome in twenty minutes.

At this point, a few details of the facilities offered by Fort Victoria may not come amiss. Situated two and a half miles from town, we possess a fairly level grass runway 4,200ft in length. The grass is kept reasonably short with the aid of a prehistoric mowing machine drawn by two extremely patient oxen and manned by two Africans, who yield easily to the gently swaying motion and are normally in a state of complete somnolence by 0800 hr.

Fire equipment was evolved by Mr. Heath Robinson in his heyday and one of his lighter moments. It consists of a cylindrical tank, mounted on two wheels, which is reputed to emit foam when three cocks are screwed in, two screwed out—and a little brass handle at one end wound furiously in a clockwise direction. As this was the original equipment that stood by for Blériot's landing on the Cliffs of Dover, some pardonable doubt does exist concerning its efficiency. In any case, it requires fourteen men and one horse to move it from its resting place—provided that the tyres are inflated.

However, a 222 call to the Town Police produced some quite remarkable results. Within fifteen minutes, arrivals at the aerodrome included: one limousine and the Police Officer In Charge; three Police Land Rovers and seven large policemen; one red Morris Ten van containing two men, 800ft of hose and ten pairs of asbestos gloves and aprons (the town fire engine); three doctors; one ambulance and three nurses; one ½-ton pick-up loaded with axes; one ½-ton pick-up loaded with fire extinguishers; four other cars loaded with eager beavers; 357 Africans (walking or running).

By this time the Argonaut was well in sight, limping slowly over the town on its downwind leg. The suspense mounted as we dispersed everything and everybody on the secondary runway near the end of the main runway to await the almost inevitable overrun. Neither was the atmosphere eased at the sight of the aircraft well down on its final approach with the undercarriage still retracted—although visions of unpleasant belly-landings were dispelled when, at approximately 300ft the wheels were lowered. And then the value of reversible-pitch propellers was demonstrated in no uncertain fashion. Brought into play at the moment of touch-down with a roar from the two inner engines, a perfect landing was effected, with room to spare. Not a lot of room. But some—slightly to the disappointment of the town's fire-fighting crew, to the relief of the meteorological officer, and to the very obvious relief of the 27 passengers who clambered down a pair of kitchen steps to firm ground. These were transported quickly into town to make appreciable inroads into the stocks of alcoholic stimulants of the local hotel and to await the arrival of a chartered Dakota to ferry them on to Salisbury.

Two-day Wonder

The Argonaut provided a show-piece for two days, together with two Dakotas that arrived on the scene the following day, containing a spare engine and a remarkably hard-working ground crew. Working under adverse conditions (which included a horde of spectators, gaggles of sticky children and numerous dazed Africans who thought they had now seen everything) the crew completed an engine change in slightly over six hours—a considerable part of the task being the removal of the new engine from its stowage in the Dakota. In this, they were aided by some remarkable co-operation from Rhodesia Railways, who supplied a mobile crane of dubious vintage which eased the task considerably, but which also removed most of the main telephone lines to Umtali during its passage to the aerodrome.

The removal of the faulty engine was carried out in a very short time and it was discovered that one piston, connecting rod and bearing had rolled themselves into unrecognizable chunks of metal and battered numerous holes in both sides of the crankcase of an extremely expensive product.

For the whole of that day Fort Victoria aerodrome resembled a big fairground, with new crowds arriving in a continuous stream of cars, bicycles, scooters and even a large yellow bus operated by a local opportunist. Children from six years of age to sixty clambered over every inch of the aircraft, while dogs fought and chased each other in circles around the undercarriage. The local hotel-keeper transformed his battered Dodge saloon into a delivery van to maintain a steady supply of solid and liquid refreshment for both crew and privileged onlookers, while the town's electrician rigged floodlights so that darkness should not interfere with activities.

The meteorological officer meanwhile rebuilt his mountain of returns in a remote corner of the office and spent hours at the telephone answering queries. And it is worthy of note that, less than one hour after the landing, he was asked to supply details of the Constellation that had just crashed in flames with 72 people on board!

However, the coming of night saw the end. At eleven p.m. the last panel was replaced and the night shattered by a roar from the new engine—saluted by a raising of numerous bottles of refreshment grasped firmly by the hard core of spectators.

An even smaller group was present the following morning at 0630 hr to watch the Argonaut use almost every foot of the runway to continue on its way to Salisbury. And it was with a sense of real regret that the met officer watched the two Dakotas follow on later in the morning—leaving the aerodrome to regain slowly its general air of tranquillity.

Straight and Level

A MERRY Christmas and a happy and prosperous New Year to you all.

● My sincere thanks to all who have sent me cards to say that this year they are not sending cards.

I much appreciate also the almost overwhelming flood of seasonal greetings that have arrived in my office during the past week or two. My p.r. manager assures me of the spontaneity of these messages, so here they are, just as they come off the huge pile:

● **Mr. Anthony Doubletalk,** Minister of Planes:

"It is indeed gratifying that, by and large, I have this splendid opportunity to send greetings to readers of Straight and Level and, indeed, to send my greetings to all its readers.

"To you all I will say this: I and my colleagues are completely open to suggestions from any quarter—I repeat, any quarter—about the problems now before us. I can promise you, with complete frankness and sincerity, that every suggestion will be kept under active review by my department and, indeed, by myself and by my successors.

"What is my final message? That is a very good question, and one which I shall consider very carefully indeed."

● **Mr. Jeremy Fruitby,** press officer, Ministry of Planes:

"I can confirm, though of course I would not like to be quoted on this, that Christmas this year falls on December 25. For the moment that is the only comment I am prepared to make."

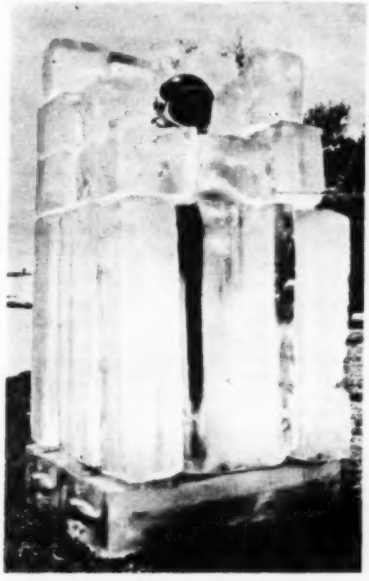
● **Sir Charles Boost,** chairman, Plummet Air Lines:

"Yet another year has gone by and still there is no decision on a British supersonic airliner. What these blasted civil servant nits think they're up to I just cannot imagine. This grand old country and Empire of ours will crumble and shrink into a second-class power if we don't watch out. We have the guts and ingenuity to lead the world, to bash the Yanks into the middle of next week, and to prove Boost's Law—namely that speed and high obsolescence rates are the foundations of profitability in the airline business, closely followed by Showing the Flag and Blue-Riband trail-blazing. Yet here we are, still messing about with turboprop airliners and talking about low fares instead of about plasma jets, solar furnaces, photon sails, thermonuclear fusion rockets and ionized deuterium jets. Anyway, a hypersonic rocket-ramjet seasonal greeting to you all!"

● **Sir John Blackout-Jones,** chairman, Scruggs Aircraft Ltd.:

"This is an appropriate opportunity for me to bemoan once again the dilettante manner in which the Government are behaving towards our revolutionary S.A.461 Speedliner project for which only £44 million of Government support has so far been forthcoming. Here is a machine which represents our native genius at its most brilliant, with an assured world market of many hundreds. Airlines all over the world are clamouring for S.A.461s, and we have already announced "firm orders" for 153, and quoted delivery dates in the latter half of the next decade. Yet without further Government aid this splendid machine will have to be abandoned.

"However, on a brighter note, I can tell you how much I am enjoying the seasonal round of cocktail parties and



Christmas message from Hospitalman First Class Marion Myers, wearing omni-environmental Mk 4 suit: "Warmest greetings. Here are the ice-cubes, who's got the Bourbon?"

receptions, and how much I am looking forward to next year's Society of Plane Makers show, that magnificent mirror of our industry in which we can all admire our own reflections, and which is an occasion with many splendid opportunities for the entertainment of Planes Ministry officials."

● **Mr. Ted Chip** ("Big Chip"), shop steward of the Plummet joint council for rivet-hole drillers and allied operatives in the workers' sectional brotherhood panel of amalgamated engineering trades and electrical fitters. His message reads:

"Our struggles on the shop floor against the feudal barons who call themselves the Plummet management continue undiminuted. Unless we get a 30-hour week, backdated to September 1, 1953, and an assurance that our rightful claim for a 35s an hour rise will be implementated, we shall take all steps necessary to procurate such a just and equitable settlement. I would not rule out the adoption of any measures which may be deemed necessitated."

● **Sir Harold Digit-Smith,** chairman, Thinx Electronics Ltd.:

"There has been a most encouraging demand this year for our Seasonal Greetings Simulator, which more and more firms are installing, either independently or on a common-user basis. Unfortunately (and I may as well be quite frank about this) the estimated demand for our Mobile Cocktail Party Unit has not yet materialized. But this is only a matter of education, and we are planning a series of nation-wide demonstrations of this Unit to every aviation firm in the country during the months immediately ahead."

● **Dr. J. Nit,** British air expert:

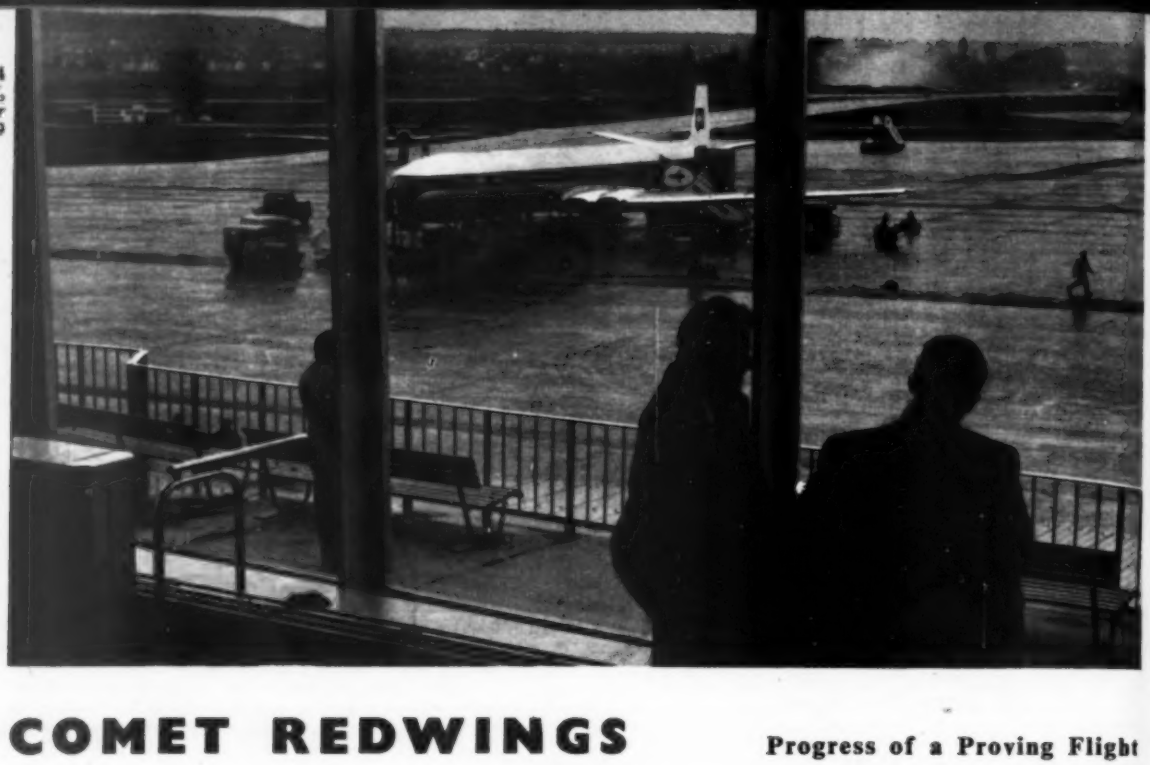
"Seasons greetings to you all. In my capacity as chairman of the Straight and Level Select Committee into the aviation brochure industry, I feel that this is a timely moment to disclose some of our findings.

"The object of our inquiry was to investigate allegations that British air firms' brochures and house magazines were becoming smaller in size and fewer in number than those of foreign competing industries. I can report that there is no cause whatever for concern: indeed, precisely the opposite is the case. Our industry produces the biggest and glossiest brochures and house journals in the world—and in the largest quantities. We find that our leadership in this important field is unchallenged. This is as it should be. After all, the brochure was invented in this country."

● **Miss Daphne Dormouse** (39-22-36). This famous cinema actress writes: "Did you know that this year there have been more column-inches about me in the *Daily Clanger* than about all other aviation topics combined?"

● And so the greetings roll in—from Professor Otto Norm, my statistician; Dr. Homer Beamish, my navigation adviser; Hamish Haut-Mode, Straight and Level's fashion consultant; Sir Archibald Jogtrotter, chairman of Turboprop Investments Ltd.; Mr. Julian Washbrain, public relations officer of either Scruggs or Plummet, I always forget which; Mr. Hugh Strangeways, former Planes Minister, now Minister of Football; Mrs. Jones of Chorley Wood, the average airline passenger; and from me—

ROGER BACON



COMET REDWINGS

Progress of a Proving Flight

"EASILY the most beautiful airliner to visit Zurich" was the tribute readily accorded to G-APMB, B.E.A.'s first Comet 4B, on its proving flight to Switzerland last week. This was one of the last of a fortnight's series (described in *Flight*, December 11) that were being conducted before the Comet is introduced into passenger services on the *ad hoc* basis that precedes formal introduction in April, May and July next year. The writer was among the 66 passengers who comprised the sample payload.

The attraction of jet flying, even over short European stage-lengths, is considerable. Viscount flight time from London to Zurich is 2 hr 5 min; the time scheduled for the Comet is 1 hr 25 min; and on the proving flight the actual return time was estimated as 1 hr 10 min—which, but for poor weather and a delaying G.C.A. at London, might have been a record.

In the left-hand seat on this fast flight back to London was Capt. G. T. Greenhalgh, manager Comet Flight, and author of "The Gentle Jet," an article about the Comet 4B which was published in *Flight* for December 11. Two senior captains, Capt. Peter McKeown and Capt. Bill Fittall, respectively occupied the right-hand seat and the systems panel that is the third pilot station, while a de Havilland engineer kept a watching brief from the fourth seat in the cockpit (there is a jump seat as well).

Once the engines were started—in a rapid 4, 3, 2, 1 sequence and with the minimum of fuss—it was Capt Greenhalgh who issued the now normal, good-public-relations warning about the Comet's steep angle of climb: "There is plenty of power available for take-off," he said, "and we are helping to reduce airport noise. I hope," he added, "that you enjoy this take-off as much as we do." And, thus prepared, everyone did.

Because the pilots cannot see the wing tips, taxying requires a good deal of caution, but there was no hanging about at the runway holding point; the Avons are wound up to their full 8,050 r.p.m. (revs are in most cases 50 r.p.m. up on those for the Comet 4) as the Comet swings on to the runway, and from that point onwards the sensation is akin to that of a gimbal-mounted lift. No blast-off this; the acceleration is smooth and progressive, and rotation and unstick come satisfyingly quickly.

Leaving London the day before, Mike Bravo had been up into the 1,000ft cloudbase before reaching the end of the runway, this despite a suspected faulty micro-switch which at first prevented action of the damper strut which allows the bogie beam to trail into the "retract" position. From Zurich the rotation and steep climb were equally impressive, with streaks of the de-frosting fluid that had been sprayed on just before take-off streaming past the windows. In the climb, the r.p.m. soon came back to 7,400, but the speed increased rapidly and the steep ascent continued.

The very steepness of the climb can make it difficult for the cabin crew of two stewards and two stewardesses to serve drinks and meals to up to 86 passengers, but in fact only on the Comet route to Dusseldorf (where the scheduled time is 1.05 hr) should the shortened flight time be an embarrassment.

To the cabin crew in the 64-passenger tourist section, the change in noise level as they walk up and down the cabin from their galley must be very apparent. Anywhere ahead of the jet efflux—that is, in *any* seat—the level is satisfactory by any standard, and the Comet is possibly quieter, seat for seat, than the Boeing 707. But it doesn't follow that the noise level decreases as you move forward, because quite a lot of air-conditioning noise comes from behind the perforated headlining cloth about halfway down the fuselage. I judged this to be at its most intense about three rows aft of the big adjustable bulkhead that separates a 15-seat tourist compartment from the remainder of the tourist seats, but it is much less apparent from the seat itself than when one is standing in the aisle. Noise level rises quite a bit in the rear galley and—not to put too fine a point on it—the two toilets at the extreme aft end of the cabin are no place for meditation; the efflux adds a vibrant roughness to a considerable level of noise.

This is a small criticism of a cabin that, in all other respects, is outstandingly good. The colour scheme—particularly the tomato and charcoal of the seats—is the best that B.E.A. have ever offered, and in conjunction with the new external colours (about which a typical comment seems to be: "The more I look at it, the more I like it") they add appreciably to the passenger's enjoyment of the Corporation's jet.

The time that we were airborne was insufficient to satisfy me that the air conditioning would continue to give as comfortable a cabin atmosphere as it did between Zurich and London. Then, temperature everywhere seemed remarkably even and the atmosphere pleasantly fresh; it was particularly noticeable that hardly anyone on board felt the need to use their punkah louvres. Indeed, the only inkling of the coldness of the outside air at 31,000ft (it was −43 deg C) was frost on the knurled head of the screw securing the inner window-frame to the cold structure. Later, during the descent, frosty white patches formed on the red wing above the outer fuel tanks.

Two other jottings from the *Flight* notebook: no one seemed quite certain whether in the longer fuselage of the 4B, pilots—and perhaps the most forward-placed passengers—would notice greater accelerations during gusts and changes of attitude than they might with the shorter Comet 4; certainly from inside the fuselage the nose seems very long. Also, the upfloat on the ailerons is quite remarkable; they are rigged with the trailing edges about 1½in higher than those of the flaps and the discontinuity along the wing is rather startling. (This unusual rigging improves stall characteristics.)

Four-minute flight planning. On European routes the flight planning for the 4B has been reduced to a nimble art; the pilots speak of doing it in four minutes and, in fact, once the data is assembled this is all the time required. Some notes on the broad outline of the method appeared in *Flight*, December 11: what follows has particular reference to our proving flight to Zurich.

The basis of planning is a series of tables that are used to reduce arithmetic to the minimum. The first step is to establish the mean wind between 20,000ft and 30,000ft from those forecast for the sector, and to calculate the mean track along the known distance

The 22-seat first-class cabin of B.E.A.'s Comet with the revived name of Silver Wing. A 15-seat tourist compartment separates the first-class accommodation from the larger tourist cabin; there are galleys and toilets at each end. In the heading picture opposite: A Comet 4B on a proving flight to Zurich is serviced by Swissair

from departure point to destination. What follows is simply a tabular method of solving the equation for which a private pilot might use a Dalton computer. The table (Fig. 1) is "entered" at the mean track value, registered against the mean wind direction, the line followed down to the intersection with mean wind speed, and the positive or negative wind component is read off.

The next table to be used (Fig. 2) plots wind component (in 10 kt steps) against sector distance to give time of flight and fuel required for take-off, climb, cruise, descent to 1,000ft and five minutes' holding at 5,000ft. Since this table must assume a particular height (29,000ft) and a particular temperature (I.C.A.N.) two other simple tables (Figs. 3A and 3B) are used to correct the full figure. These are time against altitude ± 29,000ft, and time against ± I.C.A.N. temperature. In our particular case, the distance was 468 n.m. and the wind gave us a 10 kt tailwind component. The table showed that we should require, at I.C.A.N. temperature and 29,000ft, 1 hr 9 min to cover the distance and 6,550 kg of fuel. But in fact we were to fly at a 31,500ft quadrantal and the O.A.T. was −43 deg C −I.C.A.N. −5 deg C. The height variation made virtually no difference to our time and only 50 kg difference to the fuel required—a quantity so negligible that it could be ignored, as could the correction for temperature.

To the fuel quantity, a fixed allowance of 350 kg is added for taxying, and then the same process is repeated for diversion to the alternate. So, at this stage the fuel required consists of a sum of three quantities, the last being fuel required from wave-off at destination to climb to the optimum altitude for the distance to the alternate; cruise; descent; and five minutes' circuit fuel. Finally, to the total is added a fixed allowance of 3,150 kg for 45 min holding at 5,000ft. In our case the minimum fuel was thus 12,670 kg, and as a small additional reserve 14,069 kg were loaded. (The figure was not rounded off, because the underwing dripsticks are calibrated in gallons.)

This brought our take-off weight up to 55,052 kg, comfortably under the maximum permissible figure of 71,669 kg. In fact, B.E.A.'s Comet will very rarely be weight-limited, either as to take-off weight or payload, although on the shorter stages with rather distant alternates, landing weight can be exceeded.

The Comet 4B's cruising speed is normally about Mach 0.76. Following the track from Zurich (Hochwald, Chaumont, Troyes, Bray V.O.R., Abbeville and Cranbrook to Sevenoaks, Epsom and London), we were cruising at Mach 0.75 and making about 420 kt T.A.S. on 6,750 r.p.m. Practice and experience enable the pilot to estimate quite accurately what r.p.m. he is going to require at any weight, altitude and temperature, because the cruising r.p.m. band is relatively narrow, but the exact r.p.m. can in any case be obtained from a series of carpet graphs drawn for different weights. (What the actual weight is at any time is easily calculated by summing the four kilogrammes-gone flowmeter readings and subtracting them from the take-off weight: in cruise, fuel is used at a rate of rather under 1,000 kg/hr.)

An interesting point of technique arises here. Even with the height-lock in and correct r.p.m. set up, the Comet will not achieve its correct Mach number unless its altitude is also correct. If this is not done on rounding off from the climb, the aircraft will mush along below its optimum cruising speed even if power is increased. This is apparently a stable condition, and it may require a considerable rate of descent—something like 1,500ft/min—to get the aircraft back in its groove. That this phenomenon may also be true of the Caravelle is given weight by the emphasis given to attitude flying by pilots of Air France.

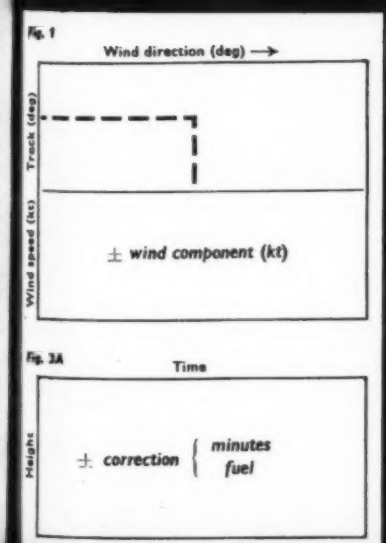
As with all jets, fuel management is important, and control is the third pilot's principal task. At intervals of, say, each half hour, it is one of his duties to prepare a fuel statement, the object of which is to show the amount of fuel in reserve and the amount that would be available at various alternate airports.

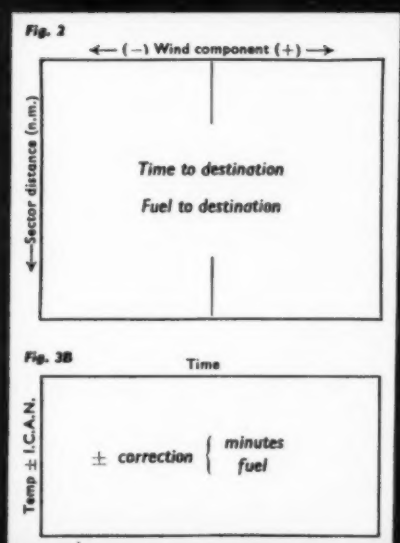
The statement is prepared by filling in on a prepared form: (a) E.T.A.; (b) observation time; (c) time to go (a−b); (d) fuel flows 1, 2, 3, 4 and total fuel flow; (e) total fuel loaded; (f) fuel used; (g) fuel remaining (e−f); (h) fuel required to destination (c×d) and reserve fuel left (g−h).

Since the amount of fuel required to reach various alternates has already been calculated, the amount that will be left in reserve for holding can be determined by subtraction. To some extent, therefore, the 3,150 kg holding fuel allowed can be regarded as being in part contingency fuel, since the quantity required for holding at 5,000ft for 45 min will allow holding for considerably longer at greater heights. What is important at this stage is knowledge of how long the reserve fuel will last at different holding heights, and the calculation of this forms a part of the weight statement (see Fig. 4). There is quite a big fuel penalty to pay if compressor air is being tapped for de-icing, and holding times are subdivided to take this into account.

All this takes longer to recount than it does to put into practice, and in fact much of it was run through for me by a busy crew flying a jet on a short sector on European airways. That this was possible is a tribute both to the essentially straightforward step-by-step techniques worked out for their Comet by B.E.A., to a highly skilled crew, and also to the essential simplicity of the aircraft itself.

Of the latter, one can only say that the Corporation's strictly commercial reasons for buying the 4B—to meet jet competition from other operators until the D.H.121 is available—takes scant regard of the genuine enthusiasm engendered everywhere by Britain's jet. Its value in prestige and profitability for the moment aside, the Comet is a wonderful way to travel. A. T. PUGH





These four diagrams illustrate the speedy method of flight planning used by the Comet 4B crews and described above

Fig. 4

Alternate	A		B		C	
Fuel to alternate						
Reserve fuel						
Holding height	with de-icing	without de-icing	with	without	with	without
	Holding fuel consumption		Holding time at alternate			

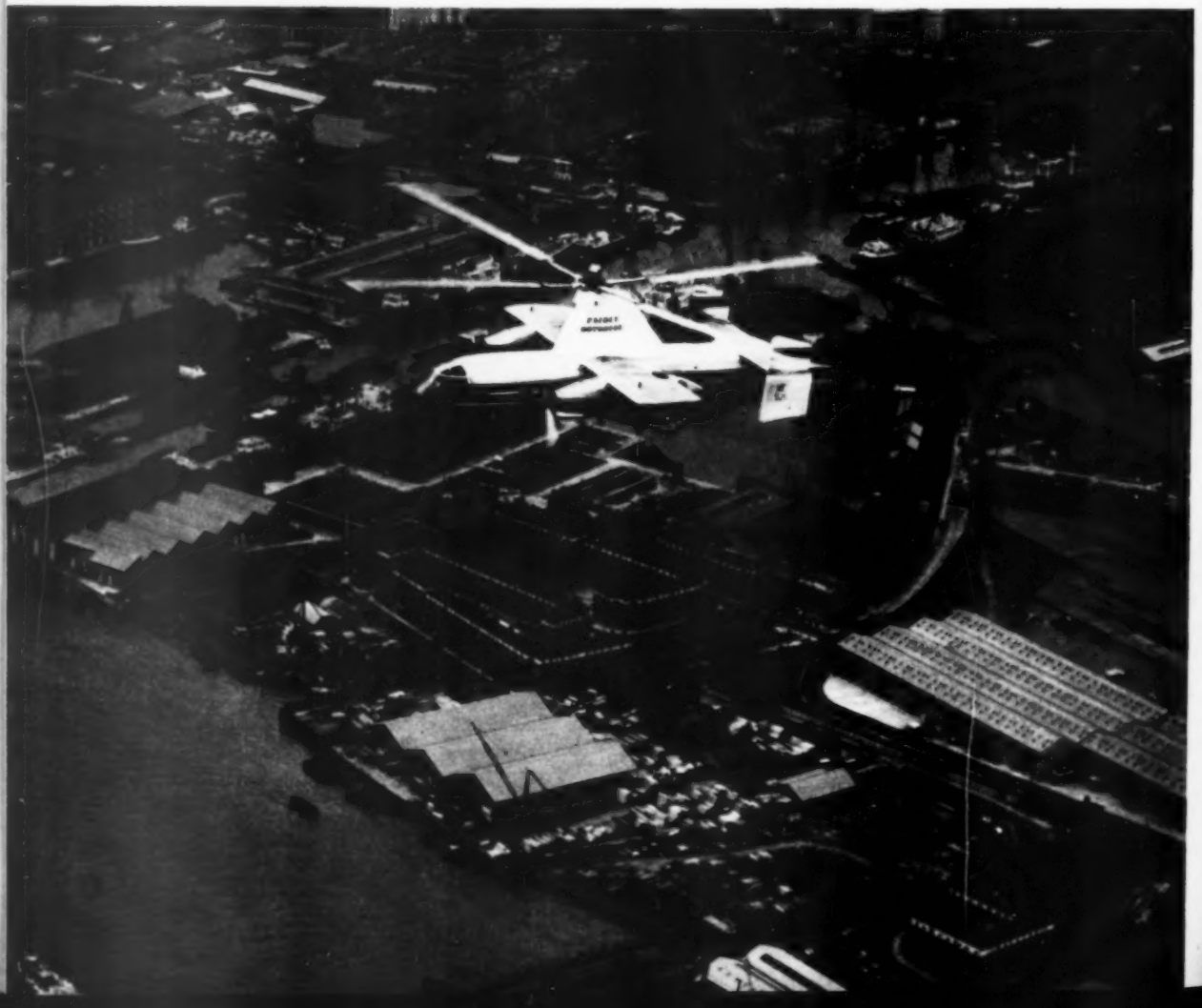
ENTOMOLOGICAL STUDY

l murmur of large insects—
bine-powered. Under the
glass are (left) Bristol's Type 192
apier Gazelles, and (above) the first
f Westland's Westminster flying
vise Napier-powered in having twin
e complete specimens are (upper left
right) the first Westland Whirlwind
ith a de Havilland Gnome, and a
Wessex with a Napier Gazelle.
re is a pre-production Saunders-
having a Blackburn A.129

W.C.2 and S.E.16

Over contrasting districts of London, and in equally contrasting conditions of visibility, are (left) three Westland Whirlwinds of Bristow Helicopters Ltd., en route for the Persian Gulf, and (below) the Fairey Rotodyne.

ENTOMOLOGICAL STUDY . . .



FLITE

AND AEROSPACE TECHNOLOGY

Cover Pic—Ace Flite airscribe digs Limey plane at famed Farnbro airsho (see p. 791). Detailed inspect revealed engine in there someplace. Continuance of internally configured engines believed predicated as of now, timewise. Note—pic shows back end of ship

Dedicated to the Advancement of International Aerospace Information among all nations of the Free World—and to the editors and staffers of all U.S. aviation magazines, but for whose inspiration and leadership in the refinement and improvement of the English language this issue would not have been possible.

Strategic Scare Command Tops .. 790

Hipsters Dig Old-Plane Rave .. 791

Konfidential Kountdown .. 791

Farnbro Meet Reveals Limey Air-biz Tempo 791

Return of Ray Dome 793

Staff: Names of publisher, managing editor, executive editor, executive managing editor, European editor, Welsh editor, Washington editor, New York editors, Los Angeles editors, Dallas editor, engineering editor, luncheons editor, avionix editor, astrionix editor, hypothetix editor, congress editor, cocktails editor, space technology editor, astro-dynamix editor, astro-physix editor, transport editor, equipment editor, aerospace panoramas editor, business flying editor, hangar flying editor, art editor, assistant art editor, special projects editor, foreign news editor, university air squadron dinners editor, London editor, Paris editor, Bonn editor, Mexico City editor, Tokyo editor, dull firms editor, defense and legislative editor, guidance and control editor, support equipment editor, advertising sales manager, promotion and research manager, research and marketing manager, business manager, circulation manager, libels manager, assistant business manager, production manager, bribes manager, circulation promotion manager, advertising promotion manager, advertising service manager, circulation fulfillment manager and other executives are listed in the directory section, pages 909 thru 954.

Sunny Burtonwood AFB bids Home-like Welcome, Offers Tripe 'n' Onions

Burtonwood, England, Europe—Situated in the heart of Lancashire's famed vacationland between Liverpool and Manchester, Burtonwood Air Force Base offers you a restful, ego-building tour of duty amid eye-pleasing English countryside (genuine health-giving chlorophyll color). Here, once you have filed your incoming clearance and checked personal weapons at Police Post 66B (a specially preserved R.A.F. "guard room," in which British defaulters were once chained in the stocks at the beginning of the century), you will be free to surveill environmental situations which will firm you up to a realization that you have retrofitted yourself into the pages of a history book.

The so-called "tight little island" is quite different than Stateside. You will at once notice British custom of driving on left of highway. Enforcization of this cute tradition is strictly ensured by friendly British "bobbies" (Highway Patrolmen), who may be distinguished by their quaint hats. As a result all base personnel with suspended licences are required to pedestrianize on the right-hand sidewalk to face oncoming traffic.

British carports will be found unsuitable, owing to excessive reduction of configuration. Autos should be provided with British license-plates, and in several cases it has been found possible to rephase the same set of plates for several years, owing to the fact that the British operation is predicated on the utilization of undated plates. Parking of trailers is permitted at several of choicest local tourist sports, including such gems as verdant Trafford Park and banks of Manchester Ship Canal above Eccles (home of famed food-stuff named for the town).

Neighborhood community to the base is

CONTINUED

Aviators Speak Same Language at US-UK Liteplane Meet

London, England—Sure was good to meet those British flyers at the bi-national liteplane meet here in England last month. With little time awastin' we dug right into a real good session of hangar-flying just after sundown, when our ships had been rolled into the hangars at London Airport and the Britishers' cute veteran biplanes had been "picketed", like they say, down for the nite at nearby Square Oax airstrip. Here's how the talk went between two Anglo-American flyin' men:—

Max Conrod (USA): Sure is good to meet you British flyers at the bi-national liteplane meet here in England. And what a smooth

CONTINUED

Flite special correspondent Suzanne Adams commutes daily in this cute X-15 liteplane made of real Tree-wood

BURTONWOOD . . .

Continued from page 789

the entrancing village of Warrington (pronounced Worringt'n). Within its mellow walls will be found a truly authentic pageant of history, including mayor's corporation, carefully restored cotton mills, friendly fish 'n' chips stores and famed pubs. In pubs, each of which has painted sign whose meaningful origin is lost in history, you will be dispensed specially warmed beer amid the company of highly motivated dukes, earls and yeomen, who are real good at spelling out stirring tales of noble activations from the past, such as Wars of Roses cricket game, Conservative and Labor parties, man-sized local ball-game (called Rugby League) and honored sport of gray hound racing (to which hounds of other colors are now also admissionized).

On the base are integrated all amenities normally scheduled for personnel and dependents assigned to undeveloped countries. For visitors and enlisted men economic housing is currently activated in the form of cosy dormitories known to our British hosts as "Niss'n huts" (see pic). Accommodation in these ranch-type dwellings is provided free, and even lush off-base apartments, each with quaint back-yard comfort station, may be leased—American plan—at rents costing moneywise not more than three English pounds sterling daily.

Domicilization with a local family will promote internal consumption capability of genuine native dishes, such as traditional York pudding, tripe 'n' onions, hot tea with cream and an out-of-this-world delicacy known as Parkin. (All foodstuffs intended for internal consumption should, of course, be procured from the base commissary, post exchange or supermarket, in order to insure your own personal, individual, pressure-sealed, germ-free, area-ruled custom-wrapping.)

For recreation you will find enlisted men's beauty shops, bowling alley, wives auxiliaries, hobby shop, aero club, Phi Beta Kappa fraternity, dumb friends league (non-human), foto club, youth activities committee, vegetarian diet circle, rocket experiment society, rod 'n' gun club, big-game hunt club, philatelic group, "push back the frontiers of science" symposium, Rotary Club, mountain-climb group, blood bank, swim pool (specially sanitized water drawn from lush Mersey river), hi-fi and ham radio, handwriting class, ski school, sport car club, genuine green grass athletic field, judo school, base theater, Save the Free World circle, dependents club (U.S. citizens only), horror-comic library, Young America "free expression" nursery, wolf-cub pack, Daughters of the American Revolution, American Legion, Veterans of Foreign Wars, car-wash (while-U-wait) & integrated pants-pressing bureau, flower-arrangement classes, nuclear fall-out study group, all-denominational religious services, life insurance office.

CONTINUED

Strategic Scare Command Tops in Motivation, Capability Stakes

DEDICATED, motivated, the men of Strategic Scare Command stand watchdog round the clock. Confidently aware of their unique capability in striving to defend all nations of the Free World; conscious of their confident awareness of their unique capability in striving to defend what we just said, these skilled practitioners in the craft of operational nuclear delivery capability are continuously alert to the Red threat that lies around the corner, across the street, down the road, in the air, on the ground, beneath the sea, round the clock and all points east.

Above the entrance to the massive, heavily defended, secret underground public relations headquarters is written the Command's motto —FISSION IS OUR MISSION. In an exclusive interview, *Flite* asked Gen. Q.Z. "Boot" Fayss, Commander-in-Chief publicity and vice-president press relations, whether an increase in the enemy's nuclear striking capability would necessarily be accompanied by an effective increase in the S.S.C. force and a devulnerablisation of its combat units. "Peace is our Release," replied the general.

On the general's desk sits the famed green candy-striped telephone, linking the underground headquarters with key units all over the Free World. On receipt of the alarm signal, lifting the famed green telephone puts the general in immediate direct contact with the Command's Madison Avenue public relations consultants—Flannel, Suit and Phonetap Associates Inc.—and with their regional offices in all quarters of the Free Globe. Are communications the key to the deterrent capability, we asked the general. "Fame is our aim," he replied.

Outside the underground headquarters is mounted a 100ft high representation—floodlit at nite—of the command's insignia—a kid-gloved hand grasping a lox 'n' lemon, with the famed green telephone in the background. Above it flashes the meaningful neon-lit message. WE BOAST THE MOST.

"Flite" foto of Royal Navy's Whirlwind antisubmarine helicopter model reveals numerous technical details. Just visible in background is Windmill girl Christine Fraser

LITEPLANE MEET

Continued from page 789

ride over! The autopilot-omni-coupler worked like a dream, feeding the course-director signals into the L-2 autopilot and providing automatic localizer interception and tracking, plus automatic enroute navigation bonuswise. You know how easy it is, of course; you just tune your radio to an omni station, turn on the L-2, push the AOC controller button and the airplane flies to the station on any selected radial. The controller head has an engage button in the center and a small toggle switch on either side. The legend for the left toggle is Omni in the up position and Heading downwise. The toggle to the right says Intercept when up and Enroute downwise. When the left toggle is in the up or Omni position the L-2 is being fed either omni or localizer information from the course director. When in the Heading position the autopilot is fed desired magnetic heading information from the course director's independent gyro-stabilized magnetic heading unit. When the right toggle is on Intercept you get a bigger cut and quicker bracket on any selected omni radial, localizer beam or magnetic course than you get with it in the Enroute position.

Radiowise, we settled for a 90-channel 5640 transmitter and 190-channel 5611 receiver, plus the 2374 Nav-Pac providing VOR and localizer signals to the 4080 visual indicator, which provides rotable omni-bearing selector, to/from indicator, course deviation needle and direct-reading reciprocal bearings. To utilize ILS facilities we had, of course, the 10-channel, crystal-controlled 5607 glideslope receiver and 4087 indicator.

How was that again? Oh, the airplane? Yeah, that was a 1960 model Supafliteautocustomplus version of the standard Pibeechna TravelPacer 180. But how about your flite and your ship?

Roger Graunchly-Hyphenate (UK): It

Ranch-type dwellings at Sunny Burtonwood — known locally as "Niss'n huts"—are skilfully landscaped to merge with verdant local countryside

Hipsters dig old-plane rave—Biggleswade Jazz-air-fest wows limey cats, rates Kingsize Nod, raps critix, slams legit Biz on upbeat

Olde Ward'n Airdrome, Biggleswade, Bed-f'dshire, England—Was a real mean rave at Biggleswade Friday nite. Like those veteran planes, man, hip but hip on a biplane kick. Rigger Mortis and his Icy Fingers made the music—real weird, y'know?—and the gang sure dug the group in a meaningful sort of way.

While true-blue notes were toted by Rigger, the fly-boys leapt skywards like crazy on the real old ships. Essee Fiveay made nimble with the loops, y'know, right way over the top, man, plus a doggo dogfite twixt Fiveay 'n' Sopwith Bop, famed WWII skyfitin' twosome.

Interviewed on flite in open-cockpit Bop in twenty-below airtemp, ace pilot Mach Lambert opined "Cool, man, cool."—END

KONFIDENTIAL KOUNTDOWN

By ERRING B. NEWSCONE

HAVE SCOOP, WILL PUBLISH

- **Watch for new disclosures on Air-force configuration deployment posture. Odds are that NPJX is inphasing outage concept on DDW via TLMR.**
- *Missilewise, Pentagon views Red threat as highly motivated. Re-shuffle in fifth-floor front offices rumored.*
- **New codenames for your notebook: IGGNOTZ—metaphysical satellite detection system; CRUNCH-BOTTLE—feasilibity study for de-creativizing logistical aspects of enemy satellite detection system; NOITCETED METSYS, alias DSSB, detection system spelt backwards.**
- *Pentagon appointment as goofleswitch directorate chief will definitely be announced Friday next. Move from NASHA motivations group likely, informed sources report.*
- **Discount unofficial rumors that Pentagon's goofleswitch directorate chief will be named shortly. Flite learns authoritatively no appointment yet slated.**
- *Reposturization concept probe urged on Capitol Hill: top scientists urge unreactivate dispersalling introfiscal fundamentals, weaponsystemwise.*

Title-change Disclosed by Airmag

London—Always in line with latest moves in magazine-title field, our associate journal *The Heavier-Than-Air Fixed-Wing Airplane* has been recently restyled in line with space-age concepts. Future issues will be designated *The Heavier-Than-Air Fixed-Wing Airplane and Astronautics*. Readers are reminded that if they miss any week's issue of *Flite*, the same news is contained in the following week's issue of *The Heavier-Than-Air Fixed-Wing Airplane and Astronautics*.

certainly is jolly nice to have you chaps here for this do. Actually, our flight here was much the same as yours, I suppose. We had to be careful on getting the aircraft out before take-off, because the Ministry haven't actually renewed its C. of A. yet since it lapsed eight years ago, and you know how awkward it can be if you're found out. A pal of mine got found out and they took away his pilot's licence, but I haven't got a current licence anyway, so I don't suppose it matters really.

Anyway, I hadn't flown the thing for three months, so I had to wipe the windscreen after pushing the machine right way up again out of the hedge. Those gales last month didn't do it any good, and I hadn't picketed it down because the chap whose gear I borrow was away on a sort of smuggling job at the time.

Well, I rolled her out, set the switches and throttle, and went round and started to swing the prop. There was nobody else around, thank goodness. Unfortunately, I didn't catch up with the old so-and-so before it sort of went into the hedge on the other side of the field, so I had to pull it out again. Thank

CONTINUED

Limey Airbiz Tempo Revealed at Socko Farnbro' Airsho

Model of British manpowered supersonic airliner is examined by typical technician Angela Smith and electronix expert N. Winterbottom. Exhibit is scheduled to appear at next month's London Airport All-England Enthusiasts Liteplane Fly-In and Bar-B-Q; Intergalactic Congress of Flite (US citizens only); and Yucca Valley Grubstake Days and Aerospace Panorama

Farnbro' Hantshire, England, Europe. Blue skies beamed down on famed Farnbro' field, as giant airshow, activated annually each year by British Society of Airplane Subcontractors got off pad. Peaceful azure heavens were criss-crossed by vapor trails as powerfullest Limey jet ships disported before giant assembly of procurement buyers-guide inventory specialists from all nations of Free World, while meaningful commentary was given by commentator Sir Stuart Olivier, whose English-type voice is heard wherever British aviating men give public exhibitions.

Liteplane enthusiasts gasped as test-flyer Ronald Proteus cavorted in tiny Austin Eaglet, whose wings were bright yellow color to show against darkening sky. After amazing maneuvers, Proteus ended on note of high drama, inadvertently letting hands slip from stick at point of landing, finally hitting runway on one wheel to show quick recovery of nerve. Next came huge Balkan H-bombing plane, which gave demonstration of deterrence. Sir Olivier called it "a V-bomber," but wing is really different shape than this, triangular configuration being purposefully glimpsed against black rain clouds. Thru forest of umbrellas could be heard roar of giant jets, revealing English ability in field of jet capability, while handling of ship revealed value as retaliatory instrument.

Biggest item on program was slated to be participation by Royal British Air Force, but Sir Olivier apologised for non-availability of certain items of hardware due to fact that crews were engaged in breaking 110-mile marching record. This dramatically shows dedicatedness of veteran air-marshals, trained to walk back from global missions. Instead,

North Wales Enters Space Race

BODELWYDDAN—Plans for phasing-in new rocket-launch facility on sheep-covered slopes of nearby Ciwydian mountain range now near finalization. Asked whether combined effort with South Wales would not produce more-integrated, better adjusted program, spokesman for NWIS (North Wales Interplanetary Society) said: "Indeed no. We must go it alone, look you. If the Isle of Man can do it, so can we, isn't it?"

Typical fliers agree flying's the same, no matter where. Left, American Conrod leaves for short half-day business trip, takes a few maps and change of sox. Right, Britisher Graunchly-Hyphenate strides eagerly across to wreckage of his veteran biplane, soon to be repaired

LITEPLANE MEET . . .

Continued from page 791

goodness I wasn't on a proper airfield with air traffic control and all that nonsense. Not that the tower controllers would have been able to see much anyway, because the fog was pretty thick by then.

I decided to check the aircraft before take-off, like those pansy instruction manuals tell you, but that was obviously a stupid idea because the wing sort of wobbled when I touched it and I couldn't see to check the tail because of the black smoke coming back from the engine cowling. So we got airborne, smartish like, and headed right away for this do.

You mentioned on-route navigation—well. I did have a map once, one of those excellent Esso ones you get at petrol stations, but we used it to patch the wing fabric with that time I landed on Horse Guards Parade.

Anyway, I set course for here, with London Airport as a turning point. I normally line-up on the beacon first, then cut across towards the control tower—the lights stand out jolly well, even in fog—and then follow the taxi lights until I cross the main runway. From there its easy down the main road, provided you remember to turn left at the Odeon. Those red firework things had just about stopped by then. So here we are. Where's the bar?

Magnetohydrodynamix symposium held recently in London's highbrow Windmill lecture-theater attracted many topline Service chiefs. Here five delegates are seen out of uniform

FARNBRO' AIRSHO . . .

Continued from page 791

mock combat was staged by Jet Riposte training planes, whose evil silhouettes menaced across storm-clouds, while sound of other jets came from squadrons cunningly concealed by rain and fog.

Then on to runway slid Britain's famed Hovercraft. Answer to America's space challenge, this mighty craft, looking much less sizeful than size leads observers to believe, was prevented from flying by hailstones. These bounced from helmets of special troops detailed to protect craft from Red spies; troops rode on deck, altho' in combat they would be differently emplaced.

BURTONWOOD . . .

Continued from page 790

credit union, ulcer-treatment, psycho-analyst and personal re-orientation groups; a stock-car speedway is located behind the high altar of the Mormon church, hot-rodders' dragster meets are held hourly on the instrument runway, bible-study and weapon-system-concept classes are held Monday thru Friday in the Jake P. Oppenheimer III Memorial Building, and a base family picnic and sunbathing area is located adjacent to the Padgate sludge-treatment plant (a temporary subsidence here has been checked back to failure of the ground-support equipment).

Free legal advice is authorized for personnel who engage in protracted contact with natives, and in Building 1574 instruction is given in English techniques and hardware, including the local language, currency, weights and measures, Beefeater color-photography and clutch-pedal and umbrella capability conversion familiarization training programme instructional classes.

NOTE: After agonizing reappraisal, Burtonwood Air Force Base is at present de-activated and without fiscal support from Federal financial monetary dollar appropriation funds. All personnel are therefore being cut back and stretched out, and incoming drafts should ensure confirmatization of their personal career status posture position situation before accepting a posting involving physical bodily presence on base. Non-dedicated enlisted men over the age of 21 may obtain accommodation on base only for personal purposes involving Project Native Son, ancestor-search programs or archæological research, upon submitting 24 copies of form AF-1134-MIL-T-1966A to the Secretary of the Air Force, United States Air Force, Department of the Air Force, Washington 25, D.C., U.S.A. These will be answered in either negative or affirmative, respectively, on revised form AF-1134-MIL-T-1966B, which will be obligated in the fall of 1960.

Show now moved to thrill-packed climax. While lightning forked from above, R.A.F. Litening—Sir Olivier called it "an all-weather fighter"—was towed past by tractor, prevented from flying by weather. Next moment manful shouts came out the fog as highly motivated personnel of British Royal Army hastened countdown of deadly Thunderbox missile. Clanking of officers' spurs was muffled by thick snow underfoot, but Britishers listened pridefully to ritual-packed orders such as "onepausetwoasyouwere," designed to phase out technical holds. Whole countdown was performed twice—Sir Olivier called this "doing it at the double"—but missile aborted at last moment owing to fog preventing launch-controller from finding button.

In final finale participating subconstructors vied with organizing officials to activate top thrill. While stolid crowd stood stolidly, partly because of being frozen to deactivated state, Ministers launched giant Black Nite ballistic missile—only to be outsmarted by industry teams, who enthused as hurricane carried off exhibition tent. British, ever ready with humorful quip—Sir Olivier at once laughingly called tent "the static show"—regarded this as highest hilite, and, as Red spies disguised as schoolboys struggled to preserve secret brochures from hailstones, Black Nite fell on scene to bring day to close. Altogether 1959 was best show yet, and all the guys in my ward opine that famed tradition must be perpetrated.

M A D

Management Analysis Dogmathronix Inc.

If YOU are aware of the analytic responsibilities as related to systems management relationships in an expanding production posture,

If YOU are qualified to inaugurate and develop entire logical systems surveys with an electronic management-philosophy emphasis,

If YOU want to live, but really live, in the storied ranch country near the sun-soaked orange-groves that Nature has located amid the fun-lovin' folk of Peanuts County, Alaska,

—Then why not join your professional colleagues who have already gone—M A D

Re-entry vehicles. Now coming on to the market are the first top-quality used re-entry vehicles, originally produced as part of the nation's defense program. We have not yet had a chance to inspect these re-entry vehicles personally, but understand that they were originally priced at $878,550 each. Intending purchasers should check with their State Hiway Department to confirm possibility of operating these re-entry vehicles on the hiway. They may prove to be just the vehicles you are seeking. Write for catalog to Filipino Grannuci's Supermarket, Beatnik Center, Jerk's Corners 76.

Job Vacant. Smart lad wanted as chief designer. Own pencil essential. Send stamped, addressed envelope. Scruggs Aircraft Ltd., Ponders End.

B-36. We are real proud to present for your perusal several of these famed 200-ton ten-engined ships, honorably retired from SAC service. These babies retail at from $500 to $37,000, according to state of radio gear and instruments; hourly flight cost is around $5,500, but this can be reduced by making your ship into a cute bar, den, nursery, hobby room or aquarium. Alternatively B-36s make a swell deterrent for Central American republics, or would suit large crop-dusting outfit. Your best friend will love one for Christmas! Call Dawson X. Flicklepeffer any time thru 9 p.m. at Orange County Airport, off North Snohomish Crest Highway.

CONCEPTUAL OPERATIONS SYSTEMS

Creative aerospace technologists with experience in retro-analytic synoptic visualization of Tomorrow's Challenging Problems of conceptual operations systems, with particular application to electronic inertial datamation in digital microwave thought-conservation programming, are invited to communicate with the Director of Operations Systems Operations, Electromatomix Technology Laboratories, Cloudburst Boulevard, Santa Clausa, Cal.

Dig These Topix?

NEXT WEEK: Flite's Annual Military Aerospace Inventory Procurement Buyer's Guide of the World issue

- **the following week: Flite's annual Commercial Aerospace Inventory Procurement Buyer's Guide of the World issue**
- **the week after that: Flite's annual Helicopter Aerospace Inventory Procurement Buyer's Guide of the World issue**
- **the following week: Flite's annual ordinary issue**
- **the week after that: Flite's annual Sport and Business Aerospace Inventory Procurement Buyer's Guide of the World issue**
- **etc., etc., etc.**

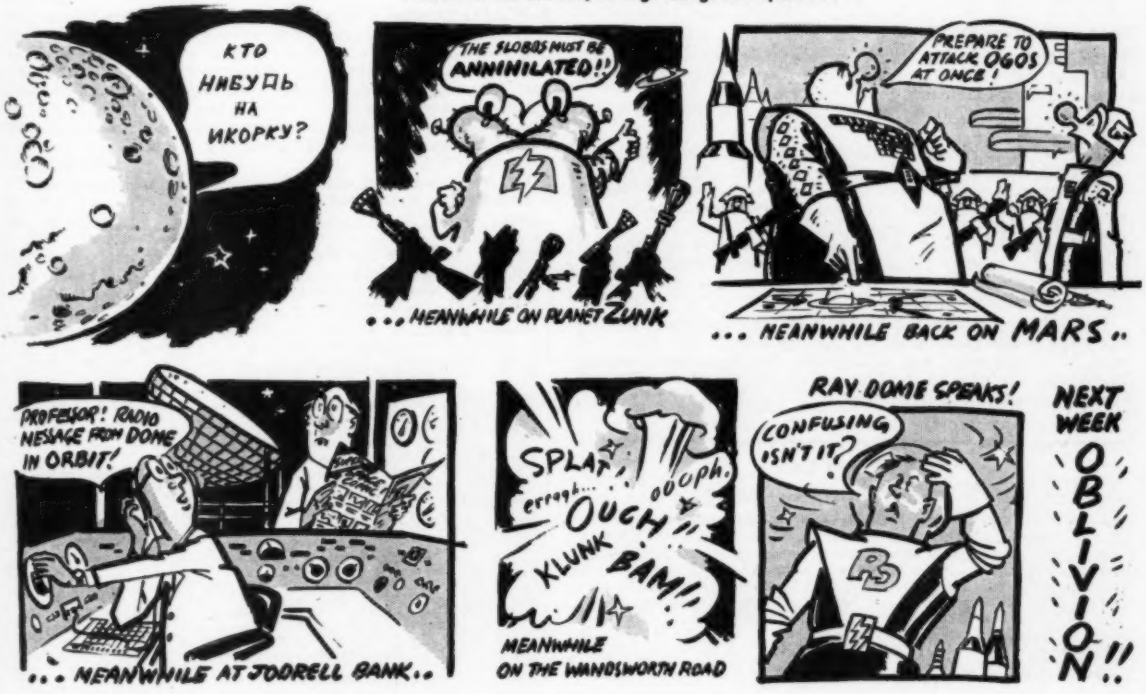
FINALIZE YOUR COPY RESERVATIONS AS OF NOW

AVAILABILITY OF THESE DEMANDWORTHY ISSUES MAY BE CURTAILED, CIRCULATION-WISE

RETURN OF RAY DOME ! ! ! !

This week: Farewell to the Red Planet, or "Mars, I miss your apple pie."

Thrown into confusion and stationary orbit around Earth by the first launching of the mammoth ICBO (Intercontinental Ballistic Ornithopter), Ray Dome, Ace of Space Presentations Inc., and Miss Smith, his personal secretary who accompanies him everywhere, are busy fitting the high-fidelity phonograph installation in their do-it-yourself space station when they are disturbed by a stream of high-energy particles. They start to paddle across the stream but are caught by a strong current. After eating the current they are attacked by Martian micrometeorites, who pause only to smile amiably as their photographs are taken by a passing Soviet Moon-probe. Dome and Miss Smith are put aboard a water-filled spaceship without food, oxygen or phonograph records, and are launched towards the Sun. They are frozen, dehydrated and packed in Eezi-Keep Everfresh Kartons for the journey. But elsewhere in the cosmos, strange things are afoot . . .



CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. The names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

The shadow observable in this photograph taken from a cabin light aircraft is the subject of the letter below from Mr. R. Cloete-Noding

Photographic Puzzle

THE enclosed photograph [reproduced above—Ed.] was taken from the rear seat of a three-seater cabin cruiser at about 4 p.m. on a clear winter day. Distance from lens to window was about eight inches, so this precludes possibility of reflection in glass. There was no visible mist in the atmosphere. A small section of wing can be seen at bottom left, which dismisses any shadow from there. So how was the shadow caused?

As a photographer of some years' standing I seldom meet with conditions for which I can find no logical explanation in the photographic medium, but there is an instance here. I know my equipment is in perfect condition, the film was normal (FP3), and the conditions under which the shot was taken were generally good. You cannot pick up a reflection of this size a few inches from a window. And yet we have a shadow filling the sky area of the negative. Perhaps your readers might worry it out. I can't.

The scene is the southern suburbs of Cape Town.

Cape Town. H. G. CLOETE-NODING.

Inspiring Experience

THE other day, for the first time, I flew above cloud in a light aircraft. The experience was almost beyond description, but I have tried to convey something of what I felt in this:—

I saw for one brief hour, or maybe less,
A field of snow, and clouds—a wilderness.
No form was there, but dark and light and mass,
Shadows and sun and eminence of air.
My limbs were weightless, earth did not exist;
I was numbed and awed and could not think or care.
There is no word for beauty such as this—
One can but feel and know that it is there.
There is no purity on earth that can compare
With these vast halls of blue and stainless air.

London, W.5. ELIZABETH BERTRAND-CLARKE.

Take-off Monitors

THE public reached by *Flight* is very large indeed. For some of your less technical readers may I add the following to your interesting correspondence on take-off monitors?

For modern aircraft a take-off may be divided into three phases:—

(1) *Power-failure speed.* Acceleration up to a point where the aircraft could be stopped without damage. At this point it has attained such a speed that an emergency stop would be unwise, but continued acceleration and take-off would be possible even after an engine failure.
(2) *Take-off safety speed.* After this speed has been attained, the amount of runway remaining is of no further interest.
(3) *Climb.* Ability to clear obstacles by margins required by relevant regulations.

Take-off weight and the above data are calculated before a flight is commenced, using (a) runway length and slope, (b) wind, (c) temperature and (d) altitude. In the cockpit existing instruments are used in the presentation of the information and in most cases this is satisfactory.

However, when take-off conditions are not the limiting factors of take-off weight, use of a power-failure speed becomes unrealistic. During an emergency it could indicate a necessity for the aircraft to continue its take-off run, when in fact ample distance remained in which to come to a stop.

A more exact indication of when a stop is no longer possible could be provided by installation in the cockpit of a landing-wheel-actuated distance indicator. With the required stop distance preset, the captain would have immediate warning that a take-off must be completed, even with loss of power due to an engine failure. Future aircraft, being more critical on take-off, may require this modification.

Once an aircraft is cleared to take off, any further form of control during acceleration down the runway would be unappreciated in normal conditions and difficult to apply in an emergency. A captain is fully occupied in getting his charge into the air or, in an emergency below power failure speed, brought to a stop without damage. Duplication of information, either visual or radio, would make further demands on his attention and could be dangerous.

At any time the captain can obtain or confirm information on conditions, both inside and outside the aircraft, affecting his take-off.

Woking, Surrey. H. T. THOMPSON.

Modern English Mis-usage

PERHAPS I am being a little pedantic, but I find my eye constantly offended by two mis-usages of the Queen's English in modern aviation jargon. *Flight* is not the only offender.

One word is "alternate," used as a noun by the airline fraternity to denote an airfield to which they may resort in the event of, say, bad weather or fuel shortage. What they mean, of course, is "alternative."

The other is "aft," used adjectivally in the context of (e.g.) "the aft cabin," when what is really meant is "the after cabin." If aviation must borrow its phraseology from the much older language of the sea, then surely it should pay sailors the compliment of doing so accurately.

London, S.W.7. PURIST.

[These two usages have become so firmly established in aviation that *Flight* has given up a losing battle and now conforms to the popular versions.—Ed.]

Shape of the 188

I WAS exceedingly interested to read about the Bristol 188 supersonic research aeroplane in your issue of December 11—and I was also highly amused to see it called, variously, "The Flying Refrigerator" and "The Flaming Pencil" by two of our leading national dailies. Be that as it may, can it really be that the Meteor configuration is the right one for a 2,000 m.p.h. research craft? I note that you suggest this point yourselves, and would appreciate further information.

London, W.C.1. D. SMITH.

[The 188 has been exhaustively tunnel-tested, and seems to work well; it resembles the Meteor only superficially.—Ed.]

RETROSPECT

From "Flight" of December 25, 1909

Aladdin Up-to-date: When Aladdin made his appearance at the Lyceum Theatre on Thursday last it was found that during the past year he had become quite up-to-date in his ideas. When he becomes wealthy in the first act he determines to invite all his friends to an aviation meet in the palace grounds. The wicked magician then swoops down and carries off the Princess in his monoplane. At one time there are five Bleriot monoplanes swooping over the Lyceum stage, and some extraordinary scenic effects are obtained in the pantomime.

FORTHCOMING EVENTS

Dec.	29.	Institute of Transport (West Middlesex Group): "Work of the Federal Aviation Agency," by Thomas T. Carter.
Dec.	30-31.	The Science Museum (Young People's Christmas Lectures): "The Story of Flight," by Victor Wall.
Jan.	6-8.	Course on Technical Information and Literature: College of Aeronautics, Cranfield.
Jan.	7.	R.Ae.S.: Young People's Lecture, "Flying and the Human Machine," by Dr. G. Melvill Jones.
Jan.	8.	Helicopter Association: "The Development and Flight Testing of Helicopters," by G. J. Sarsted and A. V. Coles.
Jan.	9.	British Interplanetary Society: Film Show.
Jan.	12.	Photogrammetric Society: "Small Scale Mapping," by Messrs. Wild Heerbrugg of Switzerland.
Jan.	12.	R.Ae.S.: 94th Anniversary Lunch.
Jan.	15.	R.Ae.S. (Agricultural Aviation Group): "Biological Factors in Agricultural Aviation," by C. V. Dadd.
Jan.	15.	Institute of Navigation: "Heading Definition in Commercial Aircraft," by J. Green and A. P. Glenny.
Jan.	16.	British Interplanetary Society: Schools Lecture, "The Scientific Exploration of Space," by Dr. N. H. Langton.
Jan.	19.	R.Ae.S.: "Some Aerodynamic Problems of Engine Installation," by Dr. J. Seddon.
Jan.	21.	R.Ae.S. (Main Lecture at Cambridge Branch): "Research at the College of Aeronautics," by Prof. A. J. Murphy.
Jan.	25-28.	Institute of the Aeronautical Sciences: 28th Annual Meeting and Honours Night Dinner, New York.
Jan.	29.	R.Ae.S. Man-powered Aircraft Group: "Engineering Aspects in Man-powered Flight," by B. S. Shenstone.

AIR COMMERCE

Ninth operator to receive the Friendship is Mac.Robertson Miller Airlines of Perth, who took delivery on December 7. This month Fokker and Fairchild Friendship flying hours should reach 100,000

COMET SETBACK FOR B.E.A.

THE protracted dispute on pay and flying hours between B.E.A. and the pilots who are to fly the airline's Comet 4Bs reached a head just before the Corporation were to introduce the aircraft into passenger service on an *ad hoc* basis: the pilots refused to take Comets on revenue flights until their claims were settled and Comet services will not now begin until the full scheduled-service date of April 1.

The pilots are claiming a pay increase of one-fifth—for a senior captain this is equivalent to a rise of £700 from £3,500 to £4,200 a year—and a reduction of two hours in the working day—claims that earned scant sympathy in the morning papers of December 14, when news of "the Supertax Strike," "Pilots seek £1,000-a-year rise" and "Pay claim stops Comets" first became widely known.

The core of the dispute seems to be on working hours rather than on salaries, some increase in which was to be expected if B.E.A. followed the pattern of other airlines operating jet services. Both sides agree in their statements that negotiations have been going on for a long while, and talks have been held with a Ministry of Labour reconciliation officer; the Corporation say that "the dispute will be settled before scheduled Comet services start" and B.A.L.P.A., putting the pilots' point of view, say that they reminded B.E.A. over a year ago that the present situation would arise when the Comet was introduced. "It did not wish to be obstructive, however, and it therefore did not object to Comet training being undertaken."

By December 15, after talks with the Ministry of Labour's chief conciliation officer, it was agreed that revenue-earning flights would be postponed by nearly four months until April 1 and that the progress of negotiations should be reviewed on January 31 and February 29 next year; any matters outstanding by March 31 would be referred to arbitration.

BOEING SETBACK FOR B.O.A.C.

SOME time ago it became clear that the A.R.B. was not prepared to give approval to the Boeing 707 for B.O.A.C. purely on the basis of compliance with American performance requirements. The history of this situation is a long one, and it is closely bound up with the gradual reconciliation of British and American performance requirements. Although these are now similar they are not identical, so it does not follow that because the aerodynamically similar Boeing -320 has been certificated to S.R.422B requirements that these can automatically be accepted by the A.R.B. In fact, there are some 17 special conditions which the A.R.B. have applied to American jet aircraft; and there are also five special conditions which apply to all American aircraft, piston or jet, swept or straight wing. It is one of these five—that concerned with performance—which is presenting something of a stumbling block.

A significant section of the requirements is that which concerns unstick, rotation and lift-off speeds in relation to the stall. The two authorities, working from different assumptions, calculate the respective speeds in different fashions; and, although the differences are well understood, jet take-off is critical enough (there is now more than a measure of doubt that the airfield performance demanded of the 707-120 by S.R.422 is sufficiently stringent) for the A.R.B. to require compliance by demonstration to British civil airworthiness requirements.

One difference between the S.R.422 and B.C.A.R. requirements is that the latter require demonstration from the ground of an aircraft's ability to unstick from a nose-high attitude. It was thus important for Boeing to show that the 707 was limited by its geometry from entering a ground stall condition during take-off, and this was the reason for the protracted tests at Edwards Air Force Base with a boiler plate and wooden-runner tail bumper. These tests, of course, take time. They are important because on them may rest the amount of payload that the -420 will be able to carry for a given length of concrete; the A.R.B. require double the margin between the minimum unstick speed and the start of rotation if a ground stall can occur. To an aeroplane moving at the take-off speed of the Boeing 707 this increased margin represents many feet of concrete.

The situation is further confused by changed thoughts within the F.A.A. Over the period of Boeing 707 certification, requirements have been revised from S.R.422 to S.R.422A and then to S.R.422B. At the time of writing the situation remains unresolved and delivery date of the -420 to B.O.A.C. is still uncertain. The conflict between safety and economics is considerable because every per cent increase in take-off (i.e., rotation or lift-off) speeds imposes on the operator the need to reduce payload or use more runway. The A.R.B.'s requirements are laid down and are firm, but the application of performance requirements is nearly always "supertuned" to strike the fine balance between practical operation and safety. Boeing must adjust the 707-420 flight manual to meet these requirements while maintaining pressure all the while—by demonstration and by argument—to avoid unnecessary performance margins which could constitute a commercial penalty for the operator.

OSLO SAYS NO

IT cannot be said that the path of B.E.A.'s planned series of Comet 4B proving flights in Europe ran smooth; poor weather at Moscow, diplomatic difficulties at Warsaw and noise problems at Oslo and Stockholm required a good many changes in the programme. In fact, when the Comet did finally visit Oslo's main airport at Fornebu it was only to be told by the Department of Traffic and Communications in Oslo that, along with the Caravelle, it would not be allowed to use the airport—which is only about five miles from the city—until 1962. On the other hand, the Comet has passed its noise tests at Stockholm and will be allowed to land there when scheduled services open in May.

After the refusal from the Norwegians, B.E.A. said they were very disappointed over the decision but that they had several alternatives (one is to use Gardermoen airport, 30 miles from the capital) and that new proposals would be put to the Norwegian authorities after a conference in London which was to be held last week.

Whatever the outcome of this meeting the airport will have established a precedent by being the first to refuse jets—significantly enough probably the quietest of the four now operating in Europe.

TEN MILLION R-R. JET HOURS

A MILESTONE in the history of the gas turbine engine was reached on Friday, December 18, when the hours flown in airline service by Rolls-Royce jet and turboprop engines reached ten million. This, say Rolls-Royce, is more than 85 per cent of the flying done by all civil gas turbines throughout the world. It has been accumulated by 58 airlines on six continents, largely by Darts in Viscounts and Friendships, but also by Avons in Comets and Caravelles.

Some of the engines that have contributed to the total have now flown, with overhauls, more than 9,000 hr and some of the hot components have been in service for 8,000 hr without needing repair. The overhaul life of the Dart is now 2,500 hr—stated to be the highest ever approved for any aero engine—and the Avon, which started service with 1,000 hr between overhauls, has increased this to 1,600 hr in 12 months. During the overhaul life no component changes or internal inspections are scheduled.

Third variant of the Conway-powered Boeing 707s to be rolled out from Boeing's final assembly line at Renton is Air-India's -437. It will enter service next spring

AIR COMMERCE . . .

Airline Flight Safety

—DISCUSSED FROM FOUR VIEWPOINTS AT AN R.Ae.S. SYMPOSIUM

THE Royal Aeronautical Society's symposium on flight safety, held in London on December 11 with Mr. Walter Tye of the Air Registration Board as chairman, brought together four speakers to examine the subject from the respective viewpoints of an operator, a pilot, an accident investigator and an aircraft manufacturer. In his introductory address Mr. Tye opined that though the subject had reached "a level of respectability" it was still one which might not be fully understood by the travelling public, even if they were becoming daily more aware of aviation problems in general. Despite the great increase in mileage flown by passenger aircraft the accident risk had not increased in proportion. However, a period was ahead in which safety had to be maintained in the face of new problems created by the use of supersonic aircraft and large helicopters.

The four participants (who spoke subject to the usual proviso that their views were their own and not necessarily those of the organizations to which they belonged) were Captain J. W. G. James (B.E.A.), Captain E. C. Miles (B.O.A.C.), Mr. P. G. Tweedie (M.o.A.) and Mr. R. H. Warde (Bristol Aircraft).

The theme of **Captain James's** paper (he was speaking for the operator) was the relativity of safety. "Safety is no accident" was an axiom which all in aviation should remember. At the same time it had to be accepted that there were no human activities which did not involve some risk. All degrees of safety were relative, therefore, all who worked towards safety were working in a fluid state in which there were no clearly defined targets. It was necessary at all times to balance the advantages and disadvantages before taking any particular step towards safety. A typical example was the merit of oxygen masks for civil pilots: safety became a balance between the remote chance of cabin failure and the reduction of pilot efficiency through having to wear an oxygen mask for long periods.

There were many ways towards safety and many different aspects of aviation in which safety had to be achieved. The requirement was for all to be processed to an equal degree. The operator should be responsible for all this, albeit the requirements of safety, passenger comfort and acceptable fares were usually in conflict.

Weather Minima

One of the examples of the balance which had to be held between safety and economic feasibility was the operator's weather minima. It was easy to lay down minima which would ensure that landings were made only in the most favourable visibility conditions. Whilst that would satisfy very high standards of safety the economic penalty of being able to operate only at irregular intervals would be too restrictive. Always an operator had to balance operational efficiency against safety. It was not immoral to weigh up the relative importance of possible incidents; it was a more scientific approach to safety to plan for a specific number of incidents rather than use too-empirical formulæ from which to derive standards of safety.

Capt. James urged more co-operation between manufacturers and operators to ensure that aircraft were not "accident-prone." That was most applicable to human errors arising from "accident-prone" design; material failures had been reduced, but human errors had remained at a constant level. The principle of the integrated weapon system might well be applied to civil aircraft design. An aircraft should be a "transport system," designed to work as a whole and not as a great number of parts and systems designed in isolation from each other; and the integrated system should include the crew. There was a tendency for basic aircraft design to forge rapidly ahead whilst methods of training, systems development and navigational aids were left some way behind.

Dealing with crew training, Capt. James suggested that the B.E.A. monitored approach procedure, whereby one pilot monitored the actions of the other, was a good example of a well-developed scheme of cockpit management—one of the prerequisites of safety. Members of a crew could not each work independently of the others; constant cross-checking was essential. From all this the important thing was to learn from the incidents which might have become accidents; and, as Maj-Gen. Caldara of the U.S.A.F. had said, "Incidents are the most valuable barometer of flight safety."

It was very important to have methods of communicating safety information. In many accident investigations it had been found that someone had known of vital factors affecting the circumstances but had been unable to communicate the information to the quarter in which it could have been put to use in preventing the accident. The objectives of flight safety must permeate through all sections of an organization, including the commercial departments. At the same time the air-safety department should be independent.

Discussing the training aspects of safety, the speaker suggested that simulators gave crews much greater confidence with which to cope with emergencies. Reflecting on recent training accidents to large jet aircraft, he was of the opinion that it was unwise to demonstrate hazardous conditions in actual flight; the simulator was the better method, both from the safety point of view and because it gave a more thorough demonstration.

Captain Miles, putting the pilot's view, knew as a practising airline pilot that the airman's interest in safety stemmed very much from the fact that the average pilot did 800 hours' flying in each year of his working life. His practical experience should be added to the data on which performance and operating requirements were based. Internationally, pilots spoke with one voice. Their fundamental argument with the rule-making authorities was: "You cannot negotiate on safety."

Referring to the opinion of operators and designers that "in most human activities there is an element of risk," Capt. Miles was of the opinion that passengers were in a weak position from which to assess safety statistics. The pilots' target was the highest possible level of safety. To achieve it it was necessary to eliminate all foreseeable accidents; and, should an unforeseeable accident occur, then immediate action must be taken to ensure that one of the same kind did not occur again. Whereas authorities made very careful checks of their safety calculations—which was as it should be—they did not make a comparable check of the economic penalties which were said to arise from some safety measures. As an example, a runway was extended to improve the take-off safety of an aircraft; the extra concrete cost money. At a later date a new aircraft type was introduced which used the same proportion of the extended runway as did the original aircraft on the shorter runway. There was therefore a reduction in available safety margin. In other words, the designer and the operator had traded the safety margin which was available from the extended runway for an increase in payload performance.

Separation Problems

Discussing the separation margins used for traffic control, which had been derived from the probability of two aircraft being in the same position at the same time, Capt. Miles emphasized that whilst that was a useful method one had to keep in mind the fact that there was such a thing as a zero probability of occurrence.

Detailing the areas of flight in which the greatest danger could occur, the speaker mentioned the landing phase and the increasing number of overshoots. This came from the pilots' concern with overshooting on marginal-length runways. He thought this was the outcome of the differences which existed between the C. of A. flight test techniques and the technique used by the average airline pilot. Certification tests should be conducted in such a way that they were more truly representative of actual airline techniques. In the United Kingdom the A.R.B. was making good progress towards that requirement.

Take-off characteristics of certain new aircraft emphasized the contention that the new performance regulations should not have been introduced until after they had been justified in practice. The burden of proof of the new regulations rested with their proposers, who had cut the safety margins of civil aviation to a finer degree than with any other form of transport.

Capt. Miles concluded his comments with the opinion that the safety authorities had tended to ignore particular accident areas because they could see no possibility of the accident rate increasing in the near future. That did nothing to prevent a recurrence, because the probability of occurrence was below an acceptable level. There were "danger areas" which were well known to all concerned, and the means to eliminate them were readily available, yet nothing was done. This led him to the last of the areas—air traffic control. There was absolutely no excuse for another mid-air collision; there must be positive separation at all times. Here was a clearly defined problem for which a solution already existed.

The Investigator's Task

Mr. Tweedie, speaking as an accident investigator, put forward views that agreed in general with those of the other speakers. The object of flight safety, he said, was to prevent accidents. The contribution of accident investigation came from the determination of the causes and the lessons which could be learnt. At one time this had been a comparatively simple job; now, with large and complicated aircraft, it was becoming more and more difficult. They might even come to a time when it would no longer be possible to ascertain the precise causes of an accident.

Reasons for the increase in the difficulties of the investigator's task were: (1) The great distances over which the modern aircraft flew; they could crash in the ocean or in remote and difficult country. (2) The need to investigate the workings of all the ground aids which had been associated with a crashed aircraft. (3) The complexity of equipment and systems. (4) The destructive power of the vast quantity of fuel normally carried. To all this were added the difficulties which had to be faced by the team of investigators working at the site of an accident which might be anywhere in the world—arctic, desert, jungle or mountain.

Mr. Tweedie emphasized that there was no substitute for detailed and thorough examination, not only of the remains of an aircraft but of all aspects of the aircraft's design, construction and operation. Investigators had not only to have the necessary experience and knowledge with which to do their work; they had to be physically fit, up-to-date with inoculations, and ready to sever domestic ties and go to any part of the world at short notice, there to face the sometimes hazardous conditions of terrain and climate.

The work of investigators in the field had to be supported by a well-equipped investigating organization. The speaker described the vast amount of work required and the extent to which a major accident required a national effort to assist the investigators; on occasions all three Services might be involved, together with the facilities of research establishments. The Accident Investigation Branch had no illusions about the magnitude of the task of finding the causes of accidents to large modern aircraft, and the help of all aviation interests would be welcomed.

(Concluded in col. 2 of opposite page)

Executives share a school desk: Attending a special three-day "executive course" on the Vanguard are (right to left) R. C. Morgan, chief project and development engineer, B.E.A.; B. S. Shenstone, B.E.A.'s chief engineer, and J. T. Dyment of T.C.A. Their instructor is W. V. Galen

THE MINISTER CUTS FARES

THE second reading of the Air Corporations' Bill in the House of Commons on December 15 was the occasion for the long-awaited decision of the Minister of Aviation on fares over British cabotage routes. After reviewing the Corporation's results this year in relation to those achieved in 1958, Mr. Duncan Sandys gave it as his opinion that the only way to generate the increased traffic needed to fill the capacity of aircraft coming into Corporation service was to "boldly cut the fares." The Minister said that he had now decided to authorize B.O.A.C. to introduce economy fares on cabotage routes to the West Indies, Africa and the Far East by amounts varying between ten and 20 per cent. (A map of British cabotage routes was published in *Flight*, October 23, page 445.) Just what level of reductions there would be on each particular route Mr. Sandys said he was unable to say until he had consulted Colonial authorities and the other airlines concerned, but it might be—as Mr. Granville, deputy managing director of B.O.A.C., suggested recently—about 20 per cent to Africa and rather less on the Eastern routes.

How will these fares affect the independent operators, particularly those with Colonial coach services, or the V.L.F. services proposed by Eagle, Airwork and Hunting-Clan? "I am taking steps to ensure," said Mr. Sandys, "that the reduction in B.O.A.C. fares shall not unfairly affect the Colonial coach routes which the independent companies have so successfully opened up." Along with other remarks from Mr. Sandys about his desire "to do everything he could to encourage their further development," this might be taken to mean that Mr. Sandys will view with sympathy applications for V.L.F. services at 50 per cent below existing B.O.A.C. (and I.A.T.A.) fares and that authorization might be given for other, lesser fare reductions on Colonial coach services.

BERMUDA, JAMAICA AND ALL THAT

ALTHOUGH reports are conflicting as to whether the British Embassy in Washington has or has not made an official protest to the State Department about PanAm's new jet service from New York to Jamaica via Ciudad Trujillo, certainly discussions have been held on the legal basis of these flights. Two flights were authorized, one on December 11 and another on December 15 (the latter was only accepted as an act of courtesy), but objections on the grounds that this service contravenes the 1946 Bermuda Agreement are to be raised if there are any subsequent flights.

Routes which U.S. carriers can operate under the Annexe to the Bermuda Agreement are Miami to Jamaica via points in Cuba; and New York or Miami to Antigua, St. Lucia, Trinidad, and British Guiana via a number of points in the Caribbean which do not include Jamaica.

PanAm have previously been operating local services between the Dominican Republic and Jamaica, and they also have a service from New York to the Dominican Republic. But the British interpretation of the Bermuda Agreement is that PanAm is not entitled to fly the whole route between New York and Jamaica.

PanAm recently announced its intention of inaugurating new jet services to Bermuda, Nassau and the Caribbean, while last month B.O.A.C. said that in February Comet flights were to begin from New York to Jamaica direct and also via Nassau. The Annexe to the Bermuda Agreement—now 13 years old—leaves room for discussion about rights on these services and it seems likely that agreement would be reached more on a *quid pro quo* basis than on strict interpretation of the Annexe. It is reported to be likely that ministers or senior officials will meet somewhere in the West Indies in February to review the Agreement as a whole.

APARTHEID AIRBORNE

BOTH Central African Airways and South African Airways have announced cheap air services for non-Europeans, but the way they are operating them spotlights the difference between partnership and apartheid. S.A.A.'s weekly Dakota service from Johannesburg to Durban, which began on December 4, is for non-Europeans only, with non-European stewards specially trained for the job. C.A.A. is planning a cheap service between Salisbury and Blantyre, to begin in January at one-way fares of £4 10s for the 300-mile sector. It is designed to make life easier for Nyasaland labour, which flocks to the industrial areas of Southern Rhodesia, but C.A.A. has carefully avoided the use of the term "non-European service." Europeans are welcome to use it if they wish, but there will be no frills in the 36-seat Dakota. The cabin attendant will be drawn from the normal cabin crew.

The "economy" fare to Blantyre compares with the normal Viscount fare of £12 12s for the one-way flight. By comparison S.A.A.'s non-European fare for the 350-mile Johannesburg - Durban sector is £6 9s single and £11 13s return, compared with the Skymaster coach fare of £7 5s single and £13 1s return and the Viscount fare of £9 13s single and £17 8s return. C.A.A. does not quote a return "economy" fare.

Both airlines' non-European passengers will continue to have the usual cabin services available to them. The difference is that S.A.A. will not seat a European next to a non-European; even if there is a waiting list the machine travels with one seat empty. In the Federation of the Rhodesias and Nyasaland there is no such ban. S.A.A. is considering training non-white air hostesses if there is a demand for its non-European services.

AIRLINE FLIGHT SAFETY

(*continued from opposite page*)

With the illustrated part of his address, Mr. Tweedie emphasized the difference in effect of an accident to a 1939 type and that of an accident to a modern aeroplane. In the first example the aircraft had descended out of control from 8,000ft. Although it was a write-off the absence of fire and the small dispersion of the wreckage made the investigators' task comparatively easy; all controls could be checked and the condition of the structure readily ascertained. In marked contrast was the 30ft-deep hole made by a jet aircraft which had dived from only 1,000ft at the now moderate speed of 250 kt.

Mr. Tweedie concluded his paper with the following recommendations: Constructors should assume that at least one of their new aircraft would suffer a major accident and should, therefore, use a system of broad colour-coding of the structure so that investigators (who might have to sort-out over 50 tons of wreckage made up of bits not much larger than a tea-tray) would be able to re-assemble the remains more quickly; all aircraft should be fitted with a crash recorder, preferably a simple device with only about six recorded parameters; the "black boxes" which directly governed an aircraft's flight should be made resistant to impact and fire damage, so that it was easier to find out how they had been working prior to the crash; and there should be a positive and recordable indication of the position and setting of undercarriage, flaps, etc.

The fourth speaker, **Mr. Ward**, considered that the constructor's direct control of safety became limited once his aircraft were in the hands of the operator. His major contribution came from the field of design for safety.

In a design organization there were many human factors to be considered. The average technician was bound by training and experience to concentrate on designing for efficiency and not necessarily for safety. Although it might be possible to disseminate design safety information to everyone on a design staff he doubted whether they could gain full benefit from it, as they were very much concerned with overcoming the many design problems with which they were confronted. He stressed the need for designing for ease of maintenance, from which improvement in flight safety came automatically.

Under the heading of design for safety the following were of importance: good aircraft performance, safe handling characteristics, efficient flight-deck design, engines free from mechanical failures and fire risks, and fatigue-free structures. Only time would show what contribution to safety was made by fail-safe structures.

The proof of design safety was not easy to show before an aircraft went into service because of the natural desire of the operator to make use of it as soon as possible after it had received its C. of A. Mr. Ward thought there was a need to rationalize flight-test schedules in order to give greater opportunity of proving the safety of an aircraft. He proposed that engine constructors should not be allowed to use the first prototype as a flying engine test-bed. As an example of a test schedule intended more thoroughly to test a new type before it went into service, the first prototype to be used for 630 hours' development flying; the second prototype, which might be completed five months after the first, would be used for 750 hours of C. of A. tests at 50 hours a month; and the third aircraft would be used on freight services for 900 hours before the granting of the C. of A.

AIR COMMERCE . . .

America's First Year of Jet Transport

SCHEDULED jet transport operations started in the United States on October 4, 1958; and a review of the accomplishments and the problems thrown up in the first year of service formed a natural subject for the recent S.A.E. National Aeronautic Meeting in Los Angeles. Six papers were presented: *The Boeing 707 in Service*, by R. M. Morgan, service manager of the transport division of the Boeing Airplane Company; *Development and Operation of the Lockheed Electra*, by R. W. Partridge, V. S. Upton and J. T. Power of the Lockheed Aircraft Corporation; *The First Year of the Jet Age—Reflections*, by F. W. Kolk, director of equipment research, American Airlines Inc.; *A Year of Jet Operation Experience at New York International Airport*, by Thomas M. Sullivan, deputy director of aviation, the Port of New York Authority; *Ground Support and Handling of Jet Aircraft*, by Gordon W. McKenzie, supervisor of engineering, aircraft systems and corollary equipment, Trans World Airlines Inc.; and *A Systems Approach to the Support of Jet Aircraft*, by Dr. C. J. Breitwieser, vice-president, engineering and customer relations, Air Logistics Corporation.

American Airlines have been operating both Boeing 707s and Lockheed Electras over the past year and, according to Mr. Kolk, "not only have these aircraft been operating at extremely high load factors, but they have led to a tremendous stimulation in business." (As regards the Boeing 707, quoting from Mr. Morgan's paper, the average passenger load factor for all operators is 92 per cent and the average utilization 7.5 hours per aircraft per day—some operators achieving as high as ten hours per day.)

American Airlines have had comparatively few operational problems with the Electra; partly because the propeller-driven machine presented no unusual characteristics, partly because it is a much simpler aircraft than the 707, and partly because of "the exceptional effort made by the manufacturers of the Electra to design the utmost of reliability and maintainability into the airframe." The 707, on the other hand, has had many "bothersome and sometimes serious problems"; it is critical in range/payload performance, airport length requirements, and noise level.

One problem which applies to all jet transports and not specifically to the 707 is, according to Mr. Kolk, the fact that certified landing distances are unconservatively short for airline operation, because of the higher approach speeds required by jets through lack of slipstream over the wings, and because of relatively inefficient thrust reversers. American Airlines recommend that the field length requirement for modern jet aircraft should be derived from the relation

$$D = \frac{V^2}{2.9} + 390$$

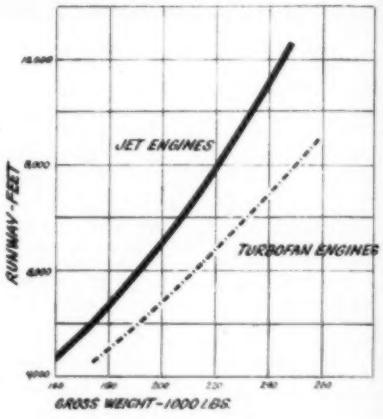
where D is the required runway length in feet, and V the approach speed, in knots, over the threshold.

On take-off, the Boeing 707's behaviour may be critical to any difference between actual and assumed conditions. "Certain take-offs have appeared to be marginal under nominal zero-wind conditions and under cross-wind conditions . . ." and gusts and turbulence also affect the take-off performance. This has led to American Airlines' assuming a 3 kt "built-in" tail-wind component for take-off for all jet aircraft operations; this automatically gives some 300ft extra runway available for accelerate-stop and also provides about 40ft additional clearance, on an all-engine take-off, at the end of the runway.

The other big problem in 707 operation is noise. Because of the relatively poor performance and handling characteristics of jet aircraft approaching stalling speed, American Airlines have been reluctant to indulge in the steep climb-out procedures requested by some airport communities. But in fact, and unexpectedly, most complaints of noise have concerned approaches rather than take-offs; and flight patterns are being revised to avoid excessive low altitude manœuvring as far as possible. Noise suppressors have been disappointing. Although they have lowered the overall decibel level, they have suppressed the low frequencies and not the high frequencies which most people seem to find more objectionable. The Port of New York Authority, represented by Mr. Sullivan, do not take quite such a gloomy view of noise suppressors, but they do agree that they are not the complete answer.

To correct these deficiencies, American Airlines are carrying out, next autumn, three major modifications to their 707 fleet: first the retro-fitting of a leading-edge glove to improve high speed performance; second the fitting of additional leading edge flaps to improve low speed characteristics and the take-off problem; third, and probably most important, conversion of the engines to turbofans—an inherently quieter form of propulsion, which also has the advantage of lower specific fuel consumption and higher take-off thrust.

Much of the ground covered by Mr. Morgan on the Boeing 707's service experiences and snags has already been reported in *Flight* (November 13, 1959, page 562). Lockheed's spokesman, quoting from Eastern Air Lines' experiences, claimed that the Electra, in operation, has shown very pleasing flight characteristics. Like the Boeing 707, however, the Electra has had systems troubles, and both aircraft have had difficulties with the Freon air conditioning system. Other troubles encountered on the Electra were excessive heating in the electrical load centre, and—the greatest headache—the compressed air starting system. All these snags have now been tracked down and remedied.



This graph shows the improvement anticipated by American Airlines in the take-off runway length performance with the Boeing 707-123

Considering jet aircraft from the ground viewpoint: at New York International Airport, to facilitate taking off over the water (to alleviate the noise problem) they have had to extend two runways, and one of these is being further extended from 11,248ft to 14,600ft this coming year. They have also found it necessary to install a blast fence 75ft from the end of the paved runway to protect adjacent highway traffic. Blast fences are also required on terminal aprons; and they have had to provide additional shoulder paving on taxiways both to prevent blast erosion and to minimize the risk of jet engines ingesting foreign objects. The Port of New York Authority think that a practical limit should be set on aircraft size, as every time a new aircraft is built, the airport operator has to lengthen runways, provide more apron space, and enlarge hangars.

Problems of handling and loading the aircraft on the ground are receiving considerable thought. Dr. Breitweiser advocates a "systems approach" to problems of maintenance and ground movement, somewhat on the lines in use in the Armed Forces, "where nearly 40 different aircraft types are being supported with five basic equipment elements which are linked together in an integrated system by means of constant gauge matched rails and roller adapters." For moving the aircraft on the ground, Dr. Breitweiser considers that a wheel-mover unit, incorporating auxiliary power and electrical generating plant, is far more efficient than a tractor and more economical than taxying under jet power.

Trans World Airlines, as represented by Mr. McKenzie, do not share this enthusiasm for wheel-movers in their present state of development. They find that taxying is the most efficient, safest and fastest method of moving the aircraft. Where towing is required, they use 25,000 lb and 30,000 lb tractors. T.W.A. have standardized ground-handling techniques and support equipment for the three different jet aircraft they have on order; it is designed to be interchangeable, without adjustment, between the aircraft.

T.W.A. are working on a preloaded baggage and cargo handling system; American Airlines have their "baggage expediter" system already in operation on the Electra and the 707. It consists of preloaded baggage containers loaded into the aircraft by a hoisting and traversing mechanism. The system is expensive, the containers are heavy and subject to wear, but it does significantly reduce baggage delivery time and—unexpectedly—has also reduced baggage damage and resulting claims from passengers. American Airlines believe that it will be increasingly adopted by other airline operators.

M. N.

B.O.A.C. JET LOAD-FACTORS

IN the four-week period ending October 17, B.O.A.C. Comet 4 load-factors in both directions across the North Atlantic for both classes of service (first and economy) totalled 89 per cent on the New York route and 90 per cent on the Canadian route. In the following two weeks the New York route achieved 90 and 95 per cent, while the Canadian route reached 95 and 85 per cent. At the same time Britannia 312 load-factors, again in the four week period ending October 17, were 55 per cent on the New York route and 71 per cent on the Canadian route. DC-7Cs recorded respective load-factor figures of 43 per cent and 48 per cent—which B.O.A.C. say is "indicative of the attraction of pure jet travel."

THE AIR FRANCE YEAR

THE annual report put out by Air France for general consumption is a curious document in that it makes no mention at all of the airline's financial position. As in previous years, the 1959 report is largely devoted to the history of the airline and to a review of the airline's equipment. This is done very well. Included for the first time is a three-page fold-out of payload range curves for each of the eight types which the airline operates compared to that of the Boeing 707 which will be operated next year. Each graph also gives an indication of a typical block speed and, although assumptions are not stated, the curves provide a useful quick reference to each of the range of types operated by France's national carrier.

In the recessional year of 1958 Air France was typical of European airlines in that it increased its traffic although at a reduced rate, but load factors, except on the domestic network, were down. The biggest fall was on international long distance services where load factor dropped from 69 per cent to 63 per cent. In terms of passengers and freight carried the airline barely held its ground; only 0.6 per cent more passengers were carried in 1958 than in the previous year and the quantity of freight uplifted slipped by 2 per cent. But these poor results were redeemed by a 7 per cent increase in freight ton miles and a 6 per cent increase in the number of passenger miles flown as a result of an increase in miles flown overall from 50,380 to nearly 55,000. Conversely the productivity figure dropped slightly: in 1957 it was 13,556 short ton miles per employee but in the last year under review this had fallen to 13,325.

NEW AER LINGUS ROUTE

SUBJECT to Government approval, Aer Lingus plan to operate a twice-weekly return service to Cherbourg from Dublin next year. The route will operate from early June to the end of September and Douglas DC-3s will be used. The fare quoted is £13 return and tickets will be valid for 60 days. This compares favourably with the 17-day excursion return fare of £15 15s on the seasonal Dublin - Jersey route.

Aer Lingus hope to complete their plans for the Dublin - Anglesey coach/air service in time to operate by the spring of 1960.

BREVITIES

It is reported that Mr. Onassis, owner of Olympic Airways, has said that the airline will buy a third Comet 4B.

T.C.A. will serve London with DC-8s on its service from Montreal via Prestwick from June 1.

Unable to sell their four Constellations, South African Airways have re-introduced them for Christmas holiday services.

Lombank Ltd., the hire-purchase subsidiary of Lombard Banking Ltd., have opened a new branch office at Lombard House, 6 Charles Street, Newport, Mon.

PanAm's Boeing 707 service to Sydney was inaugurated on December 15. Thrice-weekly services between London and Tokyo were to start on December 23.

The first of United's DC-7Fs are to enter service in March. Next year the company will increase its all-cargo capacity by 93 per cent, and it is hoped to treble the cargo ton-mile figure within five years.

An auxiliary airport to Manila International, and capable of accommodating "the largest jets" is being built at Mactan Island in the Central Philippines. It should be operational by the middle of 1960.

In what was described by a Brazilian senator as "an insane adventure" a Panair do Brasil Constellation on a flight from Rio de Janeiro to Belem last month was taken over in mid-air by rebels and landed at Argharcas in central Brazil. It was returned to Buenos Aires by two rebel officers.

The first three of the five Series 2 Twin Pioneers for Philippine Air Lines left Prestwick for Manila on December 9. The delivery flight is being undertaken by Scottish Airlines and led by Capt. D. A. Templeton. The flight was expected to take 15 days.

The last of the 400 cheaper fares to be offered by B.E.A. next year —on the routes to Gibraltar and Malta—have just been announced. The reductions will apply to all-day fares and night fares from April 1, except those on weekend day flights between mid-June and the end of October. An article on B.E.A.'s promotional fares appeared in *Flight* of December 4, page 667.

The Organization for European Economic Co-operation arranged a meeting between experts on aircraft noise at their headquarters in Paris on December 10 and 11. Countries taking part were Denmark, France, Germany, Holland, Sweden, Switzerland and the United States, and the agenda included a discussion on the importance of the problem, a summary of the research already undertaken and recommendations for co-operative action.

Aer Lingus opened a special turkey depot in Dublin to deal with their Christmas turkey airlift to various points on their routes.

The construction of a new international airport at Khartoum is under consideration by a Sudan ministerial committee.

United Kingdom airlines' traffic in October was 44 per cent more than in October 1958 (a month in which the total was reduced by the B.O.A.C. strike) and capacity operated increased by 32 per cent. The overall load-factor rose from 58 per cent to 63 per cent.

The F.A.A. have approved the Hamilton Standard 54H60 propeller which is to be used by K.L.M. and Capital on their Lockheed Electras. It is also being considered for installation on the P3V-1 naval Electra. These propellers are of 13½ft diameter and have solid Dural blades.

As previously announced in *Flight*, a new airline, Thai Airways International (T.H.A.I.), has been formed on the basis of a co-operative agreement between S.A.S. and Thai Airways Company. It has now been formally incorporated.

It is reported that Sabena have signed a contract with Sud-Aviation for four Caravelle 6s (two Rolls-Royce Avon RA.29/6 of 12,500 lb thrust each). They are to be delivered in February 1961, and an option has been placed on an additional four.

Austrian Airlines are expected to receive before the end of the month the formal agreement of the steering committee of the Austrian Parliament to buy four new Viscounts for delivery early next year. The new aircraft will be used to expand domestic services within Austria.

I.B.M. air traffic control computers installed by the F.A.A. at Washington, Cleveland and Pittsburgh are now automatically linked to the similar computer at the Indianapolis traffic control centre. This is a step towards setting up an automatic A.T.C. system in these areas.

Retiring from B.E.A. is Capt. Henry J. Johnson, who began his association with air transport with Edward Hillman over 28 years ago. At the time of his retirement he had held various commercial and sales department appointments with the Corporation, with whom he had served for 12 years.

At the C.A.B. hearing of B.O.A.C.'s application to operate a polar route from London to Los Angeles in 1961 it was said that the Corporation would offer 56 de luxe seats and 63 economy seats twice weekly; that they expected a 50 per cent load factor; and that they expected to carry 2,900 de luxe and 3,300 economy-class passengers annually in each direction.

(Right) Signatories to a Commonwealth operational agreement, Mr. Basil Smallpeice of B.O.A.C. and Mr. C. O. Turner of Qantas, hold discussions in London following the 25th anniversary celebrations of their partnership. (Left) Mr. Turner visits an exhibition of Juliet Pannett's pictures of people and places seen during the Qantas 707 inaugural world flight

John Yale, the Canadian painter who is a member of the Society of Aviation Artists, with his picture "The Last Fly-past" which he has presented to Fighter Command. On his right is A.V-M. H. J. Maguire, A.O.C. No. 13 Group, who received it on behalf of the R.A.F. at an exhibition of Yale's work recently held in London (page 750, "Flight" last week)

SERVICE AVIATION

Directors of Operations

TWO Air Ministry appointments recently announced are those of A. Cdre. G. T. B. Clayton, who from December 20 became Director of Operations (Air Transport and Overseas Theatres); and G/C. J. B. Russell, who is to be Director of Operations (Maritime, Navigation and Air Traffic Control) from January 1 onwards, with the acting rank of air commodore.

A. Cdre. Clayton, who after commanding R.A.F. Honington in 1955 went to the Plans and Policy Division of SHAPE, was awarded the D.F.C. in 1940 and a Bar to it in 1944. G/C. Russell has been commanding R.A.F. Luqa, Malta, since 1957. He won the D.S.O. in 1942 and in 1954 was made an O.B.E.

For Malayan Services

DISTINGUISHED service in Malaya has been recognized by the Queen's approval recently of the following awards to members of the R.A.F.:—

D.F.C.

F/L.s D. Geddes and P. K. Wooldridge; F/O. J. A. Boardman.

D.F.M.

Sgt. P. J. Cunningham.

B.E.M. (Mil.)

F/Sgt. K. E. B. Dally.

Mentions in Despatches

W/C. R. H. Blackmore; F/L.s M. L. Cann, K. W. Claydon and T. P. Mayer; F/O. P. H. Putland; M.Plt. R. P. F. Hill; A/Sgts. L. R. Belcher and L. S. Henry; Cpl. M. FitzCharles; Cpl/Tech. E. F. McPhillips; Sgt. I. bin Nordin, R.A.F. Regiment, Malaya; and S. A/C.s A. H. bin Badar and M. R. bin Safi, R.A.F. Regiment, Malaya.

Technical Entry Standards

AT Henlow recently the Parliamentary Under-Secretary for Air, Mr. W. J. Taylor, said that the R.A.F. was having difficulty in getting enough men of sufficient standard. In a speech at the R.A.F. Technical College he expressed concern about "the numbers that are able to get through the rather stringent tests for entry," and added: "I think we are going to have to get a lot more men. But we can't do better by lowering the standard. We would be defeating our own purpose." Mr. Taylor said he thought education standards in this country were "not high enough to meet the need." He considered compulsory education should go on beyond the age of 15.

IN BRIEF

A. Cdre G. C. Hartnell is to assume command of R.A.A.F. Butterworth, Malaya, from next month.

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The Royal Rhodesian Air Force, which at present operates Dakotas on transport duties, is to buy four Argonauts from B.O.A.C.

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Mr. W. J. Taylor, Parliamentary Under-Secretary of State for Air, is to fly to Aden in January to examine living-conditions of R.A.F. servicemen and their families. He will be accompanied by A.V-M. W. P. G. Pretty, Director-General of Organization.

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Cdr. M. H. J. Petrie, who commands No. 892 Sqn., flew out by Sea Vixen from R.N.A.S. Yeovilton to H.M.S. *Victorious* in mid-Mediterranean in 1 hr 30 min on December 8 and made the return flight in 1 hr 25 min. The overall time for his trip, which included a conference and lunch on board the carrier (positioned between Marseilles and Malta) was just over 4½ hr.

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Foreign coins extracted from gas-meters and amounting in value to £32 have been sent to the R.A.F. Benevolent Fund by Mr. T. R. Howe, commercial manager of the South-Eastern Gas Board.

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Shackletons from Ballykelly and St. Mawgan were due to drop Christmas mail and gifts on Tuesday this week to the Meteorological Office ships *Weather Reporter* and *Weather Observer* and to the R.N. fishery protection vessel H.M.S. *Undine*.

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The aircraft carrier H.M.S. *Albion*, which has been refitted since returning to the U.K. in August, recommissioned for further service on December 14. Commanded by Capt. F. M. A. Torrens-Spence, she is to sail for the Mediterranean to work-up early in February.

The first aerial view of a sight which will become increasingly familiar to R.A.F. aircrew on their way to and from the Far East: the runway, parking apron and buildings at the new air-base on Gan in the Maldive Islands. The runway stretches diagonally from shore to shore of the island, which is 1½ miles long and three-quarters of a mile wide

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